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TECHNICAL REPORT - SDC 37003-1

Study and Development of Equipment for Simulating Blind Flying
Phase B: Field Survey

American Institute
for Research
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SDC Flight Section Project 6-BA
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Robert Fitzpatrick
R. Fitzpatrick, Project Director

John C Flanagan
J. Flanagan, Research Director

- -

FOR THE SPECIAL DEVICES CENTER:

A. C. Flackbert
A. C. Flackbert, Project Engineer
Flight Trainer Section

C. P. Seitz
C. P. Seitz, Consultant
Human Engineering Branch

W. H. Angoff
W. H. Angoff, Consultant
Human Engineering Branch

Submitted:

E Arthur
for H. C. Knutson
Technical Director

Approved:

J. R. Ruhsenberger, Capt. USN
Commanding Officer and Director

SUMMARY

In order to determine the important areas of agreement and disagreement concerning simulated blind flying equipment, a questionnaire was administered to 143 Navy pilots at two air stations. Information about usage of the equipment, evaluations of various systems, and difficulties with and desired improvements in the Blue-Amber system were obtained on the basis of actual flying experience.

The most-used systems were found to be Regular Blue-Amber, SNJ Hood, and Multi-Engine Hood.

Four systems are probably at least acceptable to almost all pilots:

1. Cardboard Beak - safe in most respects and easy to use, though probably not applicable in all situations.

2. SNJ Hood - simple and adaptable, though not applicable to multi-engine planes.

3. Venetian Blind - comfortable for fliers and amenable to development, though of doubtful safety and applicable only to multi-engine aircraft.

4. Regular Blue-Amber - especially helpful in developing instrument flying proficiency, though difficult to use properly and of doubtful safety.

Respondents indicated that the Blue-Amber system causes difficulty and is in need of improvement chiefly in three areas:

1. Blue goggles reduce vision and are uncomfortable.

2. Amber panels are easily damaged and interfere with vision outside the plane.

3. Reflections from blue goggles, amber panels and instrument faces cause occasional momentary inability to read instruments.

It is probable that a few relatively easily effected improvements in any system would increase pilot acceptance of that system.

Proper and careful usage practices are important to the effective functioning of Blue-Amber. It is desirable to inform pilots of best practice with Blue-Amber equipment and of the limitations inherent in the system

I INTRODUCTION

BACKGROUND

The present report deals with Phase B of the Study and Development of Methods for Simulated Blind Flying. A previous report described Phase A. In Phase A, the methods that have been used or are in use to simulate blind flying were reviewed. The various methods were grouped under three functional categories:

(1) Two-stage systems - employ two antagonistic transparent media to accomplish selective vision. The two-color systems, Blue-Amber and Red-Green, are the only two-stage systems of importance to the present study.

(2) Hood systems - prevent vision outside the plane by interposition of opaque (or sometimes translucent) screening material. In the form of a canopy, the system is known as a Hood; when it consists of material placed flat against the windows, it is here called a Window Blind. Curtains are not separately designated.

(3) Louver systems - accomplish selective vision by means of successive (usually vertical) slats or cards angled from the windows, as if a common venetian blind were turned on its side. The Venetian Blind is the most common such system. When the slats take the form of four or five large cards, the name Card or Shield system is used.

In Phase A, the literature about these systems was searched and a number of people at all levels of experience and responsibility in instrument flying were interviewed. In the course of these interviews especially, much information was obtained which laid the groundwork for Phase B.

The most striking feature of the information obtained in Phase A was the great variety of opinions about the worth of different types of equipment. To provide a basis on which to analyze and evaluate opinions, a list of the proposed requirements of a good system was prepared. This list proved helpful throughout Phase B. With modifications on the basis of Phase B experience the list appears as Appendix A to this report.

The listing of individual preferences and of the difficulties experienced by individuals with simulated blind flying equipment was a valuable first step toward evaluation of the equipment. It was next necessary to determine the relative frequency and importance of these opinions for all individuals. The objective of Phase B was to obtain

data from Navy pilots about these preferences and difficulties in order to evaluate their significance. Secondarily, it was desired to obtain comments and suggestions which might prove helpful by clarifying the exact nature of difficulties and by stimulating thought concerning the nature of desirable improvements in the systems. In this way, it was felt that Phase B would illuminate the basic causes of disagreement and point up areas in which objective study is necessary.

THE SURVEY

Underlying principles. In determining what methods should be used to obtain the desired information, several general principles were followed. Four of these should be mentioned, since they applied throughout:

(1) The results needed to be statistically adequate; i.e., based on a sufficient number of cases and obtained in a form amenable to statistical treatment.

(2) As far as possible, the statements of pilots should not be restricted by limitations on manner or extent of response.

(3) Results should be based on actual pilot experience and not on hearsay or theoretical considerations.

(4) The cooperation and active interest of pilots should be obtained.

The form of the survey. In order to obtain a large amount of information in a limited time, a modified questionnaire technique was used. Pilots, in groups of from three to eighteen, filled out individual questionnaires in the presence of an interviewer.

Rating scales were provided in the questionnaire for the expression of opinion. The ratings were later converted into numerical scores for statistical analysis. In all cases, space was left so that the respondents could modify or clarify these opinions. This method made the task relatively easy for the respondents, so that their cooperation was assured. At the same time, they were able to state their ideas as fully as they desired.

For the purely factual questions, responses were pre-categorized in most cases, so that the respondent needed merely to check the appropriate answer. This was not done when a great variety of responses was possible. For example, one question asked in what type of plane a system had been used. Since there are so many different aircraft, they were not listed and the respondents were asked to list the planes.

The nomenclature of simulated blind flying equipment is unstandardized and confusing, even to experienced pilots. The practice is to call any system a hood; pilots generally have no need to differentiate among "hoods". There are other similar sources of confusion, particularly in regard to the blue goggles used with the Blue-Amber system. It would, of course, have been possible to define all terms in detail as they appeared. But this would have been dry reading for pilots, who know the systems but not the particular nomenclature adopted. It is doubtful whether many pilots would have read these definitions at all. The interviewer was able, with the aid of photographs, to define terms in a short time. Further, he answered questions about the definitions and checked to see if the respondents had used any terms which might be subject to more than one interpretation.

The presence of the interviewer was desirable in other ways. He indicated the reasons for the survey and the use that would be made of the results. Although the interviewer stressed the voluntary nature of the task, it is probable that the respondents completed the questionnaire forms more adequately than they would have in the absence of an interviewer. Further, many of the pilots made additional verbal comments to the interviewer. These comments were often helpful in interpreting the meaning of written responses.

Finally, the interviewer was able to make sure that the sample was not biased because of failure of some respondents to "return" the questionnaire. Only two assigned pilots failed completely to fill out the form - one because he was Staff Duty Officer that day, and the other because of sudden illness. In several cases, the interviewer obtained responses by discussing the need for and aims of the survey. For example, many of the student pilots were reluctant to respond, since they felt that their experience was too limited. After discussion, all of these students completed the questionnaire.

<u>The content of the questionnaire</u>. The questionnaire was concerned more with Blue-Amber than with any other system. More Navy pilots have used this system and more of the detailed comments gathered in Phase A referred to it. The Navy will probably continue to use Blue-Amber for some time. In view of this, Phase D of the present study is to be devoted chiefly to the writing of a manual for pilots recommending procedures to be followed in order to get maximum benefit from use of the present Blue-Amber equipment. Emphasis on this equipment in the questionnaire was therefore desirable.

The determination of the exact information to be sought was primarily a matter of choosing the important questions from among a great number which might have been asked. This was done by reference to the tentative List of Requirements and by consideration of the value of each item for further phases of the project. In order to make sure that responses were based on actual experience, respondents were asked to specify the systems they had used. Few details were requested about the particular features of the systems, however, since there are a great number of minor

variations possible in all systems. If these variations had been taken into account, it might well have been found that no two pilots had used exactly the same system.

For convenience in treatment, the questionnaire may be broken down into four parts:

1. General information. Questions were asked about pilots' general experience and specific use of the various systems. This information is discussed later in this section and in section II.

2. Evaluations of systems. Respondents were asked to rate each system they had used on the basis of how well each system meets particular aspects of the requirements of a good system. The results of these evaluations are treated in Section III.

3. Experiences with the Blue-Amber system. Pilots indicated the experiences with and opinions about Blue-Amber in two areas:

> a. Difficulties experienced with the system. From Phase A interviews, a number of possibly significant difficulties had been obtained. With reference to the List of Requirements, the more important of these were chosen and phrased in fairly specific terms. Frequency of occurrence and seriousness of each difficulty were indicated by the pilots on rating scales and in free comments. Specific questions of interest were also asked concerning many of the difficulties.
>
> b. Improvements most needed in systems. A list of ten possible improvements was provided. Respondents were asked, first, to add to the list and, second, to rank in order the five most-needed improvements.

Section IV deals with difficulties experienced and improvements needed in Blue-Amber.

4. Comments. Comments were obtained, both in response to specific questions and as spontaneous contributions by pilots. A section of particular interest requested description of actual incidents illustrating good and poor features of the systems. These incidents and many other comments are reproduced in full in Appendix D of this report.

The questionnaire was administered at two places: Corpus Christi Naval Air Station and Norfolk Naval Air Station. On the basis of experience at Corpus Christi, several minor changes were made in the form before it was used at Norfolk. The complete form is shown in Appendix B, along with a list of the changes made.

ADMINISTRATION OF THE QUESTIONNAIRE

Pilots were assigned by squadron commanders. The names of assigned pilots, however, were not made known to the interviewer. It was made clear that responses would be anonymous, unless a pilot particularly desired to sign his name.

When the group had assembled, the interviewer gave a short talk. The points covered in this talk have been mentioned above. The interviewer emphasized his willingness to answer any questions. The questionnaire forms were then distributed. Most pilots were finished in thirty to forty minutes. Four pilots spent over an hour at the job. As each pilot finished, the interviewer leafed quickly through the completed booklet to find omissions and possible difficulties in interpretation. An attempt was made throughout to maintain an informal atmosphere.

The sample. A total of 143 completed questionnaires were obtained, 103 from Corpus Christi and 40 from Norfolk. As far as can be determined, there are no essential differences between pilots at these stations and pilots stationed at other Naval activities.

It was not considered necessary, or even desirable, to obtain a completely random sample of Navy pilots. The aim was to have representative members of certain groups which were considered likely to have a particular point of view because of their specific experiences. Student pilots, pilots of single-engine planes, pilots who have used a system less than ten hours and student instructors are examples of such groups. A particular difficulty lay in finding pilots who had used such systems as Venetian Blind and Red-Green, which are very rarely used at present. It was requested that a large portion of interviewees be relatively experienced pilots. Tables XX through XXIII in Appendix C provide further descriptions of the sample. It should be noted that the particular arrangement of these tables does not imply that relationships are present or not present. The number of hours of use of the Regular Blue-Amber system is not necessarily related to the status of the pilot at the time he used the system. It was merely found convenient to indicate these two things in one table.

As far as is known, no bias existed in the assignment of pilots. These assignments were made by squadron or other activity commanders on the basis of availability for relief from other duties. In general, all pilots were thus available some of the time.

Many pilots were found to be actively interested in the problems of simulated blind flying. Several expressed their pleasure in being asked for and in giving their opinions. Whether actively interested or not, most pilots appeared to be answering the questions in a thoughtful and conscientious manner. The interest evidenced by these officers was stimulating to the interviewer. It is felt that the results are valid insofar as this interest was maintained.

II SYSTEMS USED

DEFINITIONS OF SYSTEMS

As has been pointed out, systems are not clearly and consistently defined in general usage. It was for this reason that the functional categories discussed on page 2 were developed. However, the common vocabulary is not completely confused. For everyday conversation, it is adequate. Since there was provision in the present study for checking on misunderstandings, it was considered best to rely on common usage rather than introduce a new system of nomenclature. Definitions are given in Table I for the systems used by the pilots sampled in the present study. More complete descriptions of these systems, as well as photographs of examples of most of them, appeared in the Phase A report.

USAGE OF SYSTEMS

Of the 140 respondents, 131 had used the Regular Blue-Amber system. The other two-stage system, Red-Green, had been used by only 11 of the pilots. It was inevitable that such a disparity should occur, since Red-Green materials have not been supplied by the Navy since 1945. In general, only pilots with considerable length of service and breadth of experience in the Navy have used the system. Several of the other systems have been used very little by Navy pilots. It is apparent that there are difficulties involved in this situation, not only because of the small numbers of respondents for some systems, but also because the pilots who have used these less common systems are representative of only part of the whole group of Navy pilots. Table II shows the number of respondents using each system. A further breakdown is provided by military rank, since rank is a rough index of both length of service and amount of experience.

Table III provides further information on this point by showing the number of respondents who evaluate both of a pair of systems. It shows, for example, that eight pilots used and evaluated both Regular Blue-Amber and Red-Green. This was done in terms of evaluations, since it is in the evaluation of the systems that the factors mentioned above are of most importance.

From these tables, it can be seen that Regular Blue-Amber and the SNJ Hood were used by over a hundred of the respondents. There were 108 respondents who had used and evaluated both systems. In both cases, the military ranks of these respondents ranged from Aviation Cadet to Commander, in proportions which are quite likely representative. The results obtained with these two systems, separately and comparatively, need to be interpreted only with the caution necessary in making any generalization on the basis of a sample.

On the other hand, consider Single-Engine Hood and Multi-Engine Hood. Ten pilots had used the Single-Engine Hood; none of these were from

TABLE I

DEFINITIONS OF SYSTEMS
AND ABBREVIATIONS USED IN TABLES

RBA - Regular Blue-Amber Amber acetate panels are placed on some or all cockpit windows and blue acetate goggles or visor are worn by the pilot.

BBA - Beak-Type Blue-Amber The pilot wears blue goggles or visor to which is attached amber sheeting, shaped and placed so as to prevent vision outside the plane when the pilot's position is normal.

VB - Venetian Blind Apparatus resembling a venetian blind turned sidewise is placed on windows with slats arranged to prevent vision by the pilot but give maximal vision to check-pilot. Ordinarily used only on left-front window, occasionally with a canvas shield on the right. Usually about 12 slats for a window.

SNJ - Hood in SNJ The hood, with supplementary flaps, which forms an integral part of the rear cockpit of SNJ (AT-6) aircraft.

HSE - Single-Engine Hood Hoods in all single-place or tandem-seat aircraft except the SNJ. Typically, they are quite similar in outward appearance to the SNJ Hood.

HME - Multi-Engine Hood Hoods in all aircraft with side-by-side seating.

WB - Window Blind Opaque (or, less frequently, translucent) materials are placed against the windows - usually only the left front window - parallel to the plane of the window.

RG - Red-Green Green panels on windows; red goggles on pilot.

CS - Card or Shield About five large opaque projections are angled from the windows. Principle of operation is the same as in VB, but more window area is ordinarily covered.

CB - Cardboard Beak Opaque material, usually cardboard, is shaped and worn in the same way as the amber acetate in the BBA system. Goggles are not necessary.

CNH - Compartment in NH-1 A closed compartment, with instruments and controls, was built into the old NH-1 behind the regular cockpit.

TABLE II

FREQUENCY OF USE OF VARIOUS SIMULATED BLIND FLYING SYSTEMS, ACCORDING TO PRESENT RANK OF RESPONDENTS

System	AC	ENS. (2d Lt.)	LT. (jg) (1st Lt.)	LT.(sg) (Capt.)	LCDR (Maj.)	CDR. (Lt. Col.)	TOTAL
RBA	5	20	48	43	14	1	131
BBA	3	8	8	7	2	0	28
VB	1	0	10	9	5	0	25
SNJ	10	22	39	40	11	1	123
HSE	0	0	2	6	2	0	10
HME	3	7	22	26	11	1	7
WB	2	4	2	4	2	0	14
RG	0	2	6	1	2	0	11
CS	0	0	1	0	0	0	1
CB	0	2	2	3	1	0	8
CNH	0	0	3	1	0	0	4
Total, Each Rank	10	22	49	45	16	1	143

TABLE III

NUMBER OF RESPONDENTS PROVIDING EVALUATION SCORES FOR PAIRS OF SYSTEMS*

	RBA	BBA	VB	SNJ	HSE	HME	WB	RG	CS	CB	CNH
RBA	127										
BBA	22	22									
VB	23	3	24								
SNJ	108	19	15	119							
HSE	5	0	1	5	6						
HME	31	2	9	24	2	36					
WB	10	1	1	2	0	1	14				
RG	7	1	1	5	0	1	2	7			
CS	1	0	1	1	0	0	0	0	1		
CB	6	2	0	6	1	0	0	0	0	6	
CNH	3	0	0	3	0	0	0	0	0	0	3

(Notice that the upper diagonal line shows the total number of evaluations made for each system.)

*Including those respondents whose evaluation responses were incomplete.

the two low-ranking classes. Unless other observations are available and in line with the findings, these data can do no more than suggest possible relationships. For the Multi-Engine Hood, more cases are available: 70 had used it, although only 36 provided evaluations. These numbers are large enough to provide reasonably reliable results. But an attempt to compare this system directly with the Single-Engine Hood would be of little value, for only two pilots had used and evaluated both.

These two examples indicate clearly the need for care in interpreting results. In fact, no results at all will be shown for two systems, Card or Shield and Compartment in NH-1. The problem, however, is not as difficult as it may seem. This is so because the least commonly used systems are generally also those about which pilot opinions are needed least. It was found that useful results could be derived from the data. It is only necessary to bear in mind the need for caution and, often, the need for indirect methods of analysis.

III RESULTS - EVALUATIONS OF SYSTEMS

THE METHOD

Treatment of responses. Pilots were asked to rate the systems on the basis of six criteria: Safety, Comfort, Proficiency, Time Lost, Accomplishing Purpose, and Overall. The following instructions were given:

> "Rate below each system you have described on the previous pages. Make your rating on the basis of how well you think the system meets the particular aspect of requirements of a good system. Two of the aspects need some explanation: Time Lost, which refers to time spent in handling, installing and adjusting the equipment - time which might better have been spent in flying; and Accomplishing Purpose, which is a shorthand way of asking how well the system allows you to accomplish your purpose which is to develop or maintain proficiency in flying instruments. Note, too, that the Overall rating will not necessarily be an average of the others; you should take into account all aspects of the requirements for a good system (we may have overlooked some)."

Ratings were made on a five-point scale - Very Good, Good, Fair, Poor, Very Poor. This was considered to be approximately a linear scale; e.g., Very Poor is just as far below Poor as Poor is below Fair. The ratings were therefore converted into numerical scores of 4, 3, 2, 1, and 0, respectively, for statistical analysis. Table IV below, summarizing this information, is provided as an aid in reading the tables to follow.

TABLE IV

CODING OF EVALUATION RESPONSES
AND ABBREVIATIONS OF CRITERIA

Very Good = 4	S = Safety
Good = 3	C = Comfort
Fair = 2	P = Proficiency
Poor = 1	T = Time Lost
Very Poor = 0	A = Accomplishing Purpose
	O = Overall

The meaning of the criteria. There were two reasons for the development of six criteria on which systems were to be rated. First, it was thought helpful for the pilots in making their ratings to have a reminder of the need to consider a system from several points of view. Second, it seemed desirable to be able to break down the evaluation of each system, as an aid to what might be called diagnosis. If, for example, a system was rated high in everything but Time Lost, it would be worth while to investigate the possibility of improved design of the fastenings of the equipment, or of other improvements which might decrease lost time.

The criteria were developed by consideration of the List of Requirements for a good system (Appendix A). The writer and another staff member abstracted criteria from this list independently. Then, through discussion, the two lists were combined into the first five criteria listed above. These five are considered to cover all essential requirements. The Overall category was then necessary, if only to avoid the problem of what weights to use in combining the first five into a total score. To make the list comprehensive, it was necessary to have some overlapping. This overlapping is quite obvious for such criteria as Proficiency and Accomplishing Purpose. It is perhaps not so obvious that Safety overlaps Comfort, but a pilot will certainly not be comfortable if he is concerned about his safety. Judging from comments made by pilots, however, they had no difficulty in discriminating between any two criteria. As long as the factor of overlapping is taken into consideration, it is felt that the use of several criteria was valuable.

All of the other criteria overlapped with the Overall criterion. The extent of overlap, or more specifically, the amount of correlation, between each criterion and the Overall criterion provides an index of the relative importance to pilots of each of the five criteria. Product-moment correlation coefficients were computed between each criterion and Overall for the Regular Blue-Amber system (since the number of respondents was largest for this system). These coefficients, showing extent of agreement of pilots' Overall ratings of this system with their ratings of it on the basis of each other criterion, were as follows:

Safety	.56	(N=118)
Comfort	.56	(N=118)
Proficiency	.63	(N=116)
Time Lost	.44	(N=115)
Accomplishing Purpose	.60	(N=117)

These correlations are somewhat surprising. It was to be expected that Time Lost would not correlate as highly as the others. But the writer, at least, would have guessed that Safety would be most closely in agreement with the overall rating. Safety, on the basis of these data, is no

more important than Comfort.

It is possible that safety is not so important to pilots as is generally thought. On the other hand, these results may simply be an indication that safety is not a critical factor in discriminating between types of simulated blind flying equipment. At any rate, a hasty generalization is not warranted on the basis of this one index. From the point of view of objective evaluation, safety is obviously an extremely important factor. The point here is that the pilots in this sample made their ratings of systems less on the basis of Safety than of other considerations. Perhaps these other considerations, which are more directly concerned with the value a pilot gets from practicing blind flying, need to be given more emphasis in the design of the equipment.

EVALUATIONS BY THE WHOLE GROUP

Data. In Table V, evaluations of systems are summarized. (A more complete summary appears as Table XXIV in Appendix C.) Two systems, Card or Shield and Compartment in NH-1, have been omitted from these tables because of the extremely small numbers of cases.

It may be seen that the mean evaluation scores vary considerably among systems. For example, we see under Safety that the average rating of the Cardboard Beak is midway between Good and Very Good, while Single-Engine Hood rates just a little closer to Poor than to Very Poor. On the other hand, it should be noted that there are often "clusters" of systems. Under Safety, there is a group of four systems rated between Fair and Good and another group of three between Poor and Fair. At the same time, it is of interest to consider the standard deviations. These show the extent to which opinions of individuals vary around the group opinion of a particular system. Regular Blue-Amber, judging by its mean score, stands about midway among the systems in Safety. But, with a standard deviation of 1.04, there were doubtless individual pilots who considered it best and others who considered it worst of all systems in respect to safety.

The relative positions of the systems may be seen more readily by reference to Table VI. This table presents rank-orders of systems in two ways. In part A, the table entries are ranks; the relative effectiveness of a particular system in meeting the various criteria is emphasized. For convenience in considering the relative effectiveness of various systems in meeting a particular criterion, the entries in part B are the systems.

Judging from these tables, the best liked systems are SNJ Hood and Cardboard Beak. At the opposite end of the scale are Single-Engine Hood, Red-Green and Multi-Engine Hood. Although most comments and interpretations are reserved for a later section, a few are in order here.

SNJ Hood and Single-Engine Hood. Perhaps the most striking point in these results is the great difference in evaluation of SNJ Hood and Single-Engine Hood. In general, there are no major physical differences between the SNJ Hood and hoods in other single-engine planes. The determining factor in the preference of the SNJ Hood appears to be that this hood

TABLE V

MEANS AND STANDARD DEVIATIONS OF
EVALUATION SCORES BY ALL RESPONDENTS
FOR THE NINE MOST-USED SYSTEMS

Safety

	Mean	SD
Regular Blue-Amber	2.44	1.040
Beak-Type Blue-Amber	2.86	1.188
Venetian Blind	2.54	1.193
SNJ Hood	2.88	1.093
Single-Engine Hood	.67	.742
Multi-Engine Hood	1.22	.949
Window Blind	1.50	1.239
Red-Green	1.71	.889
Cardboard Beak	3.50	.500

Comfort

	Mean	SD
Regular Blue-Amber	2.46	.941
Beak-Type Blue-Amber	1.86	1.295
Venetian Blind	3.46	.858
SNJ Hood	2.64	1.185
Single-Engine Hood	1.17	1.064
Multi-Engine Hood	2.86	1.112
Window Blind	3.29	1.267
Red-Green	2.29	1.152
Cardboard Beak	2.83	.908

Proficiency

	Mean	SD
Regular Blue-Amber	2.79	.883
Beak-Type Blue-Amber	2.52	.863
Venetian Blind	2.90	.899
SNJ Hood	2.94	.848
Single-Engine Hood	1.67	1.100
Multi-Engine Hood	2.72	.995
Window Blind	2.93	1.096
Red-Green	2.29	.430
Cardboard Beak	2.70	.400

Time Lost

	Mean	SD
Regular Blue-Amber	2.07	1.135
Beak-Type Blue-Amber	3.05	1.168
Venetian Blind	2.76	1.012
SNJ Hood	3.11	.905
Single-Engine Hood	1.67	1.100
Multi-Engine Hood	2.37	1.101
Window Blind	2.57	1.240
Red-Green	2.29	.686
Cardboard Beak	3.50	.764

Accomplishing Purpose

	Mean	SD
Regular Blue-Amber	2.99	.776
Beak-Type Blue-Amber	2.52	.917
Venetian Blind	2.89	1.182
SNJ Hood	3.05	.820
Single-Engine Hood	2.50	.500
Multi-Engine Hood	2.79	.882
Window Blind	3.00	1.000
Red-Green	2.43	.488
Cardboard Beak	2.83	.397

Overall

	Mean	SD
Regular Blue-Amber	2.55	.861
Beak-Type Blue-Amber	2.38	1.224
Venetian Blind	2.61	1.116
SNJ Hood	2.86	.918
Single-Engine Hood	1.33	.571
Multi-Engine Hood	2.13	1.005
Window Blind	2.33	1.035
Red-Green	1.75	.682
Cardboard Beak	2.83	.397

TABLE VI

RANK ORDER OF MEAN EVALUATION SCORES BY ALL RESPONDENTS FOR THE NINE MOST-USED SYSTEMS

A. Ranks of Systems

System	Safety	Comfort	Proficiency	Time Lost	Accomplishing Purpose	Overall
	Criterion					
Regular Blue-Amber	5	6	4	8	3	4
Beak-Type Blue-Amber	3	8	7	3	7	5
Venetian Blind	4	1	3	4	4	3
SNJ Hood	2	5	1	2	1	1
Single-Engine Hood	9	9	9	9	8	9
Multi-Engine Hood	8	3	5	6	6	7
Window Blind	7	2	2	5	2	6
Red-Green	6	7	8	7	9	8
Cardboard Beak	1	4	6	1	5	2

B. Systems Arranged by Rank

Rank	Safety	Comfort	Proficiency	Time Lost	Accomplishing Purpose	Overall
1	CB	VB	SNJ	CB	SNJ	SNJ
2	SNJ	WB	WB	SNJ	WB	CB
3	BBA	MHE	VB	BBA	RBA	VB
4	VB	CB	RBA	VB	VB	RBA
5	RBA	SNJ	MHE	WB	CB	BBA
6	RG	RBA	CB	MHE	MHE	WB
7	WB	RG	BBA	RG	BBA	MHE
8	MHE	BBA	RG	RBA	HSE	RG
9	HSE	HSE	HSE	HSE	RG	HSE

is built into the plane by the manufacturer. Most Single-Engine Hoods are of the "homemade" variety, which are likely to be hard to fasten and insecure when they are fastened. Witness the experience of one pilot with a black hood in an F6F aircraft:

> "Experienced pilot was flying black hood with chase pilot; instrument plane in dive, gained excessive speed and panel of canopy became disengaged; rush of air caused black hood to encase pilot's head and approximately three minutes elapsed before he freed himself of hood. Luckily he was at high altitude when casualty occurred."

This sort of accident could probably not happen with an SNJ Hood, which is supported by sturdy ribbing.

This is not to say that the SNJ Hood is a perfect system. Several serious complaints about this system were received in questionnaires, and especially in Phase A interviews. The hood is secured in front by a catch, which may be released from either cockpit. After a period of use, the catch often becomes worn and releases the hood at unexpected times. In order to effectively prevent vision outside the aircraft, most units attach supplementary flaps over open spaces at the front. These flaps vibrate noisily at flying speeds and occasionally come loose under pressure of the air. Further, since the flaps are attached to both the hood and the cockpit wall, the automatic-release provision mentioned above will not function until the flaps are removed.

The point, however, is that even a little planning and engineering apparently make for great differences in effectiveness of simulated blind flying equipment. It seems quite probable that the SNJ Hood could in turn be improved greatly by refinements in design and construction, provided that these refinements are based on knowledge of the actual limitations of the system.

<u>Beak-Type Blue-Amber and Cardboard Beak</u>. These two systems function in essentially the same way. The "beak" projects out and slightly downward from the pilot's forehead so that his vision at the level of the windshield is blocked unless he lifts his head. Advantage is thus taken of the fact that a relatively small object close to the eye will cover a considerable portion of the field of view.

As its name implies, the Cardboard Beak consists of some such opaque material as cardboard. Beak-Type Blue-Amber, on the other hand, makes use of the two-color principle to provide an effectively opaque beak. The reasons for the development of the latter system are clear. For the beak, a material is needed which is light in weight and fairly durable. Amber acetate probably fulfills these specifications better than any other material readily available at Naval Aviation activities. As far as can be determined, single-engine squadrons were the first to use Beak-Type Blue-Amber. Ordinarily, pilots in single-Engine planes wear some kind of goggles,

so that the fact that the system involves goggles makes little difference to these pilots from the point of view of comfort.

From the point of view of convenience, however, the use of blue goggles is undesirable since this blue is hardly the best color for normal flight. All in all, the blue goggles are unnecessary here and the system is thereby inefficient. This shows up clearly in the results under discussion. Beak-Type Blue-Amber was consistently rated lower by pilots than Cardboard Beak.

Multi-Engine Hood and Window Blind. The Window Blind was consistently given higher ratings than the Multi-Engine Hood. In a functional sense, these systems are the same since they operate by simple obstruction of the pilot's view. In fact, in a case of curtains hung close to the windows, it would be difficult to differentiate between the two. What, then, accounts for the difference in pilots' opinions of them? Three factors seem to be important:

1. A Window Blind does not ordinarily cover all the window area, so that some vision on the part of the safety pilot is possible on all sides. Hoods usually block nearly all vision on the left side.

2. The Multi-Engine Hood is placed relatively close to the pilot. Thus, it restricts air circulation, prevents vision of overhead instruments and often gives the pilot an uncomfortable, closed-in feeling. Further, the pilot is in some physical danger if part of the structure should come loose. Window Blinds are as far from the pilot as possible within the cockpit.

3. Construction and installation of the Hood are more difficult. Efficient support and easy fastening for the Window Blind are provided by the window structure.

One pilot summed up the disadvantages of the Multi-Engine Hood when he said that it is "not only dangerous but a mental hazard."

Limitations of the approach. It is apparent that the evaluation ratings have meaning only in a relative sense. One pilot's "Fair" may be another pilot's "Good". It is entirely possible that one system may have been rated better than another simply because the pilots who have used that system are less critical than other pilots. Unless both systems are represented by adequate random samples, it is then not strictly accurate to compare systems on the basis of the samples.

However, it is not to be expected that a completely consistent bias should be operative; i.e., that all users of one system should be more critical or more lenient than all the users of another system. Not only is there likely to be a good deal of agreement about the meaning of the points on the scale, but it is also probable that the agreement within a particular group will be just about as good or as poor as the agreement among groups. Thus we expect the groups to be similar in amount and direction of bias. If our purpose is merely to rank the groups in order

of preference, the analysis for the whole group is good enough.

The advantage of this analysis is that it has given an overall picture of preferences for systems and of possible relationships among these preferences. With this general picture in mind, the more detailed analysis to follow may be more readily understood and evaluated.

COMPARATIVE EVALUATIONS

Discussion. From what has been said, the need is clear for equitable comparison of evaluations of systems. This comparison was made for pairs of systems, by considering responses of only those pilots who had used both systems. In this way, it was relatively certain that the systems had been evaluated in the same way; i.e., with the same meanings attached to the points on the scale.*

For many pairs of systems, it was not possible or desirable to make such a comparison. No pilot, as may be seen in Table III, used and evaluated both Single-Engine Hood and Beak-Type Blue-Amber. Even if it were feasible to compare all systems, it is doubtful that it would be desirable to make all of the 55 possible comparisons. For one thing, some of the systems can be used only in single-engine planes and others only in multi-engine planes. It would be useless to compare a single-engine system to a multi-engine system for the needs in simulated blind flying are quite different in the two types of aircraft.

Comparisons were made, then, of Regular Blue-Amber with each of nine other systems. Regular Blue-Amber was chosen as the base system because it was the most-used system, because it is applicable to all types of aircraft, and because it apparently occupied a midway position in rank order of preferences of systems.

Data. The results are summarized in Table VII. More complete information is given in Table XXV, Appendix C. It should be pointed out that the differences shown in Table VII are absolute differences, since these are the best estimates of the true values for all Naval pilots. However, these values are not equally reliable. The number of cases and

* Even by this method, of course, there is some uncertainty. An individual may not apply the same scale of values to two systems, either because of unconscious prejudice or because of a shift in point of view. It was no doubt difficult, for example, for pilots to maintain a consistent point of view in evaluating Safety for Regular Blue-Amber, in which the chief detriment to safety appears in terms of vision by the check-pilot outside the plane and Beak-Type Blue-Amber, where safety is most likely to be endangered because the beak is unwieldy and likely to bump into things. However, it is felt that pilots were aware of this difficulty and attempted to take it into account as far as possible. Certainly pilots are the people most qualified to do so.

TABLE VII

MEAN DIFFERENCES IN EVALUATION SCORES BETWEEN
REGULAR BLUE-AMBER AND EACH OF SIX OTHER SYSTEMS,
WHEN ONLY THOSE RESPONDENTS USING BOTH SYSTEMS ARE INCLUDED✓

	Safety		Comfort		Proficiency	
Regular Blue-Amber vs.	N	Mean Diff.	N	Mean Diff.	N	Mean Diff.
Beak-Type Blue-Amber	22	-0.81*	22	0.69*	21	0.29
Venetian Blind	23	-0.32	23	-1.17**	22	-0.27
SNJ Hood	108	-0.37**	107	-0.12	106	-0.04
Single-Engine Hood	5	2.20*	5	2.00*	5	1.40*
Multi-Engine Hood	31	1.49**	31	-0.62*	31	-0.16
Window Blind	10	1.30*	10	-0.70	9	-0.11
Red-Green	7	1.29**	7	0.14	7	0.57
Cardboard Beak	6	-1.58**	6	-0.50	5	-0.10

	Time Lost		Accomplishing Purpose		Overall	
Regular Blue-Amber vs.	N	Mean Diff.	N	Mean Diff.	N	Mean Diff.
Beak-Type Blue-Amber	21	-1.24**	21	0.29	19	0.03
Venetian Blind	22	-0.57*	22	0.09	22	-0.31
SNJ Hood	105	-1.05**	106	0.03	100	-0.23*
Single-Engine Hood	5	1.20	5	1.20**	5	1.80*
Multi-Engine Hood	30	-0.03	31	0.20	28	0.46*
Window Blind	10	-0.10	10	-0.10	8	0.25
Red-Green	7	0.29	7	0.86*	6	0.92*
Cardboard Beak	6	-2.50**	6	-0.17	5	-0.80*

✓ Positive numbers indicate a difference in favor of Regular Blue-Amber
* Difference of doubtful significance (10% level)
** Significant difference (2% level)

significance or non-significance should also be taken into consideration.

A significant difference is one that may be expected to occur in the same direction in other samples. A non-significant difference may be readily accounted for on the basis of chance. Here, two levels of confidence in statements of significance are used. A difference is considered significant if a value of such magnitude would be expected to occur by chance two or less times in a hundred: the 2% level. At the 10% level, a difference is considered of doubtful significance.

Several interesting relationships may be noted in Table VII. These will be considered in the following paragraphs, classified according to the system being compared with Regular Blue-Amber. For convenience, the relevant part of Table VII is repeated each time.

Beak-Type Blue-Amber. The differences between Regular Blue-Amber and Beak-Type Blue-Amber mean evaluation scores are:

	S	C	P	T	A	O
Mean Diff.	-0.81*	0.69*	0.29	-1.24**	0.29	0.03
No. of Cases	22	22	21	21	21	19

Two of the differences are in favor of the Beak-Type. There seems to be no question that more time is lost with Regular Blue-Amber, which involves installation of panels on the windshield or canopy. In addition, pilots tend to feel that the danger of poor vision through these panels is greater than the danger of physical injury from the beak.

But the Regular system is probably more comfortable for most pilots. Also, there appears to be some tendency to consider that the job at hand is better accomplished with this system. The net result is that there is very little difference in Overall evaluations of the two systems.

Although it is likely that the comfort of beaks could be improved by use of lighter materials and by better provisions for attachment, it should be kept in mind that part of this discomfort is inherent in the system. The pilot must keep his head in a fairly constant position in order that the system will function correctly. This is likely to be not only physically tiring, but emotionally frustrating as well. (The reader is referred to page 14 et seq., Appendix D, for some emotional comments by pilots.) It was the interviewer's impression that some pilots would not accept any kind of beak system.

Venetian Blind. The Venetian Blind is clearly more conducive to comfort than Regular Blue-Amber and probably easier to install quickly. In general, pilots tend to favor it over Blue-Amber in every respect except Accomplishing Purpose.

	S	C	P	T	A	O
Mean Diff.	-0.32	-1.17**	-0.27	-0.57*	0.09	-0.31
No. of Cases	23	23	22	22	22	22

It is important to keep in mind the fact that Venetian Blinds are attached in most installations to the left-front window only. Thus the preference for the system as to Safety, Comfort and even Time Lost may be due merely to the fact that less window area is covered. Two questions are appropriate:

1. Can sufficient simulation of instrument conditions be obtained by covering only one window?

2. Are requirements of safety adequately served by the Venetian blind <u>in the particular visual area</u> over which it operates?

In answer to this second question, it is believed that most pilots would say yes. But it is questionable whether a pilot is able to determine this subjectively, since the factor of additional clear window area is always present to complicate the necessary judgment.

<u>SNJ Hood</u>. On the basis of results for the whole group, it is somewhat surprising to find that the Overall preference of the SNJ Hood to Regular Blue-Amber is of only doubtful significance.

	S	C	P	T	A	O
Mean Diff.	-0.37**	-0.12	-0.04	-1.05**	0.03	-0.23*
No. of Cases	108	107	106	105	106	100

Since the SNJ Hood is specific to a particular plane (that plane being to a great extent used only for the specific purpose of training), there is some doubt of the validity of comparison in this case. Most of the respondents evaluated Regular Blue-Amber on the basis of experience in some aircraft other than the SNJ. Of the 108 pilots who had used both systems, only eight had used the Blue-Amber system <u>in the SNJ</u>. It was thought to be of interest to compare the evaluations of the two systems made by these eight pilots:

	S	C	P	T	A	O
Mean Diff.	0.25	0.25	0.06	-0.13	0.26	0.19
No. of Cases	8	8	8	8	8	8

Again the results are surprising. None of these differences are of even doubtful significance; but it should be noted that, for all criteria except Time Lost, the differences are in favor of Regular Blue-Amber.

It is felt that this second table represents a somewhat more valid statement of the situation than either of the previous analyses, although the results are less stable because of the smaller number of cases. Perhaps the reader will be convinced of this validity if he considers possible

differences in Safety between the two systems. In the SNJ, with either system, the vision of the safety pilot is not affected, since the front cockpit is always clear. Therefore, except in rare emergencies, the only dangers are those of physical injury to the pilot or of distraction which might cause the pilot to grossly mishandle the controls. Because of the supplementary side flaps used with the SNJ Hood, these dangers (remote though they may be) are present with this system to about the same extent as they are with the Blue-Amber system. Certainly it does not seem that the difference in Safety should be a significant one, as it is in the first table and as it appears to be from Table V.

The conclusion, then, is that there is little difference in evaluations of these systems. Again, it should be pointed out that minor changes in the SNJ Hood would very probably improve the system to a great extent. Of course, improvements are also possible in Blue-Amber, but these are not so readily apparent.

Single-Engine Hood. In light of previous comments about the Single-Engine Hood, the results shown are about as expected. Despite the small number of cases, it can be said with some confidence that Blue-Amber

	S	C	P	T	A	O
Mean Diff.	2.20*	2.00*	1.40*	1.20	1.20**	1.80*
No. of Cases	5	5	5	5	5	5

is preferred to the usual Hood system in single-place or tandem cockpit aircraft. As a check on the validity of the comparison, another analysis was conducted for the three pilots who had used both Single-Engine Hood and Regular Blue-Amber in a single-engine plane. The Overall difference was even greater (2.33**) and the others changed very little.

As an incidental supplement to the discussion on page 13 of SNJ Hood vs. Single-Engine Hood, mean evaluation scores of these two systems were compared for the five pilots who had used both systems in the SNJ. Results were quite similar to those obtained in the analysis for the whole group.

Multi-Engine Hood. This system is clearly not as safe as Regular Blue-Amber. It is probable that it does not and could not meet minimum safety requirements unless a lookout is maintained by another crew member

	S	C	P	T	A	O
Mean Diff.	1.49**	-0.62*	-0.16	-0.03	0.20	0.46*
No. of Cases	31	31	31	30	31	28

on the port side. Most safety pilots are understandably reluctant to delegate responsibility for safety. Safety considerations are probably of

primary importance in determining the small, but consistent, preference for Blue-Amber.

Window Blind. Here a fairly definite preference for Blue-Amber in terms of Safety is apparently balanced to some extent by slight preference.

	S	C	P	T	A	O
Mean Diff.	1.30*	-0.70	-0.11	-0.10	-0.10	0.25
No. of Cases	10	10	9	10	10	8

for the Window Blind in other respects. Here again it is doubtful if minimum safety needs are met by the Window Blind. In the usual installation, the blinds cover the lower half or more of the front windows. This obviously means that about half the potential field of view to the front is obstructed.

Red-Green. According to the best experimental evidence, Blue-Amber is a better system than Red-Green, chiefly because vision is better through

	S	C	P	T	A	O
Mean Diff.	1.29**	0.14	0.57	0.29	0.86*	0.92*
No. of Cases	7	7	7	7	7	6

the amber panels than through the green used in the older system. The present results agree, no doubt partly because pilots have been told that Blue-Amber is better. In addition, however, it seems likely that improvements in installation and other procedures have been effected at most Naval activities since the days of Red-Green.

Cardboard Beak. Safety and Time Lost appear to be the chief determinants of the preference for the Cardboard Beak. A popular feature of the beak in the area of safety is that unobstructed vision is immediately

	S	C	P	T	A	O
Mean Diff.	-1.58**	-0.50	-0.10	-2.50**	-0.17	-0.80*
No. of Cases	6	6	5	6	6	5

available by simply pushing it up or removing it.

Strictly on the basis of these data, the Cardboard Beak is the most popular system. However, the data for this system are based on quite a small number of cases, so that this generalization is probably unwarranted. It is important to consider what factors other than the inherent worth of the system might be present to account for the preference shown here. One such factor was discussed in the Phase A report. New systems, such as the Cardboard Beak, are ordinarily developed by pilots to minimize difficulties

experienced with other systems, difficulties which are particularly annoying to those pilots. Often, pilots will argue for a system because it eliminates these difficulties, rather than on the positive basis that the system has features desirable for simulating blind flying. In general, the use of a new system is voluntary, since the older system is usually still available for use. Thus, it is probable that some pilots had an opportunity to use the system, but did not do so. Obviously, these are the pilots who would be most critical of the system.

Probably, then, the evaluation scores for the Cardboard Beak are somewhat inflated. It is also probable, however, that these scores would still be high if more pilots had used the system. Several pilots who had not used the beak evinced an interest in the system after hearing about it from the interviewer and from other pilots in interview groups.

Limitations of the approach. It has been pointed out that some of the comparisons are of doubtful validity. In general, however, it is felt that comparison with Regular Blue-Amber is the most equitable method in considering all systems.

In interpreting the comparisons, it should be remembered that the systems were not directly compared by the respondents. Evaluations were made by choosing a point on a rating scale for each system. Rating scales were presented on the same page of the questionnaire for all systems, so that respondents presumably marked all systems from the same point of view and on the basis of the same scale of values. But, if the comparisons had been made directly by the pilots, the results might have been somewhat different. Of course, it is not to be expected that these differences would have been great.

This indirect method of comparison was used partly for reasons of administrative facility, but - more important - it was used to prevent direct operation of the "halo" effect. Consider a pilot who strongly prefers system A to system B because he thinks system A is safer. In comparing A with B, this pilot will tend to emphasize the superiority of system A, not only for Safety, but also in such a logically uncorrelated area as Time Lost. Of course, he might do the same thing in rating the systems individually, but it is reasonable to assume that the "halo" would be emphasized in a direct comparison and minimized if the systems are considered separately. It seems important to minimize this effect, especially since the five criteria are, on the whole, logically intercorrelated (e.g., a pilot who feels unsafe will also feel uncomfortable and may not fly as proficiently as he might). It is therefore impossible to detect the operation of the halo effect.

Another limitation inherent in comparisons of systems is that this approach emphasizes the opinions of more experienced pilots to the virtual exclusion of those who are less experienced. In general, it is desirable to emphasize the opinions of experienced pilots. But the opinions of student pilots, for example, are also important because the method used to simulate blind flying may have a definite influence on the development of

instrument flying skill. The opinions of less experienced pilots will, however, be important only if they tend to be different from those of more experienced pilots. Apparently this is not the case in the present sample. Using total flying hours as an index of experience and Overall evaluation scores for Regular Blue-Amber as being typical of all evaluation scores, a correlation coefficient was calculated to determine the relationship between experience and evaluation ratings. The relationship was, for practical purposes, zero ($r = -.08$, $N = 118$). A student pilot with 40 hours in the air apparently means much the same thing when he says a system is "Good" or "Fair" as does an older pilot with years of experience.* It is felt, therefore, that the results obtained may be considered to apply to pilots at all levels of experience.

EVALUATIONS BY SUB-GROUPS

Discussion. In addition to general flying experience, there are several measurable factors which might operate to produce differential experience among pilots. Some of them have been mentioned; others will be apparent from consideration of the information sections of the questionnaire (Appendix B). Only two will be treated here. (One other is covered briefly in Table XXVI, Appendix C.) These two not only are of logical importance in evaluation of the worth of systems, but also appeared from inspection of the data to show definite trends.

In analyzing these factors, the aims were (1) to determine if certain sub-groups of pilots have opinions differing greatly from those of the whole group, and (2) to investigate such differences to see if they may not indicate serious deficiencies or important needed improvements in the systems.

Plane type. The function of simulated blind flying equipment differs somewhat with different cockpit arrangements. The chief difference is that the safety pilot's vision need not be restricted in a tandem-cockpit aircraft. For a single-place plane, the same is obviously true since the safety pilot is in another plane. On the other hand, in the usual multi-engine plane with side-by-side seating, his vision is restricted by all systems -- though to only a small extent by the beaks. There are other differences, some of which will be discussed later.

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* In contrast, consider the relationship between hours of use of the Regular Blue-Amber system and evaluation scores for that system. The coefficient here was .385 for 115 cases; pilots having more experience with Blue-Amber rated it higher. Though the relationship is not great, the coefficient is significantly different from zero at the 1% level of confidence. If there was no relationship, the probability of obtaining a sample value as large as .385 would be less than one in a hundred. Clearly, then, experience with a system affects evaluation scores more than does general flying experience.

Four of the systems may be used in both types of planes: Regular Blue-Amber, Beak-Type Blue-Amber, Red-Green and Cardboard Beak. Analyses were conducted for the first two only because of the larger numbers of respondents for these systems. For the present purpose, Red-Green may be represented by Regular Blue-Amber and Cardboard Beak by Beak-Type Blue-Amber. The results are summarized in Table VIII in terms of differences between means. The actual means, along with other detailed information, may be found in Table XXVII, Appendix C.

All three possible comparisons are shown for Regular Blue-Amber. For the Beak-Type, only one is shown, since there was just one pilot who had used the system in both plane types. An illustration may perhaps make more clear the meaning of the entries in Table VIII. Consider Safety for Regular Blue-Amber. Pilots who have used the system only in planes with tandem or single-place seating rate the system lower than do pilots who have used it only in planes with side-by-side seating. Pilots with experience in both plane types tend to rate the system higher than do either of the other groups, and significantly so as compared to the tandem-cockpit or single-place group.

Side-by-side pilots, then, consider Regular Blue-Amber safer than do tandem pilots, who seem to prefer a system which allows immediate clear vision as soon as instrument practice is discontinued. On the other hand, it is likely that tandem pilots feel more comfortable with the system than do side-by-side pilots, who are probably bothered most by the unaccustomed necessity for wearing goggles. The two groups seem to rate the system as a whole at just about the same level. However, pilots in the Both group consistently give Regular Blue-Amber higher ratings than do the others. These pilots with experience in both plane types were presumably taking all aspects of the situation into consideration.

Clearly the Beak-Type is better liked in tandem planes. Some reasons for this differential preference have already been indicated. Essentially, beaks are less desirable in the usual multi-engine plane because the instruments are scattered over a wide area in the cockpit. The beak cannot be shaped so that vision of all instruments -- especially overhead instruments -- is possible while vision outside the plane is obstructed. In addition, the necessity for wearing goggles is unpopular with side-by-side pilots.

This last-mentioned difficulty does not, of course, apply to the Cardboard Beak. It is likely that the difference between the two groups of pilots in evaluating the Cardboard Beak for Comfort would be somewhat less than that shown for Beak-Type Blue-Amber. There would, however, probably be some difference in the same direction. In other respects, results for the Cardboard Beak would be expected to be about the same as shown for the Blue-Amber beak.

Status of respondents. Closely related to effects of plane type on preference is the factor of status. Status is used here in a functional sense to refer to the job performed by the respondent. Seven jobs were

TABLE VIII

DIFFERENCES IN EVALUATIONS OF REGULAR BLUE-AMBER AND BEAK-TYPE BLUE-AMBER BY RESPONDENTS USING THE SYSTEMS IN DIFFERENT TYPES OF PLANES.✓

	A. Regular Blue-Amber			B. Beak-Type Blue-Amber
	Tandem Pilots vs. Side-by-side Pilots	Side-by-side Pilots vs. Users in Both Types	Tandem Pilots vs. Users in Both Types	Tandem Pilots vs. Side-by-side Pilots
Safety				
Mean Diff.	-.59**	-.22	-.81**	1.33*
No. of cases	109#	97	46	21
Comfort				
Mean Diff.	.40*	-.50*	-.10	1.33*
No. of Cases	108	96	46	21
Proficiency				
Mean Diff.	.28	-.72**	-.44*	1.31**
No. of cases	107	96	45	20
Time Lost				
Mean Diff.	-.10	-.50	-.60	1.63**
No. of cases	108	94	44	20
Accomp. Purpose				
Mean Diff.	-.07	-.54**	-.61**	1.56**
No. of cases	108	96	46	20
Overall				
Mean Diff.	-.01	-.67**	-.68**	2.09**
No. of cases	100	90	44	19

✓ Positive differences indicate higher evaluations by the first-named group.

* Difference of doubtful significance. (10% level)

** Significant difference. (2% level)

It should be noted that the number of degrees of freedom in all cases is N-2.

TABLE IX

DIFFERENCES IN EVALUATION SCORES FOR REGULAR BLUE-AMBER AND VENETIAN BLIND ACCORDING TO STATUS OF RESPONDENTS AT TIME OF USE✓

A. Regular Blue-Amber

Criterion	Pilot vs. Safety Pilot Mean Diff.	N	Pilot vs. Both# Mean Diff.	N	Safety Pilot vs. Both# Mean Diff.	N
Safety	.65	57	.02	120	-.63	75
Comfort	.36	57	.10	120	-.26	75
Proficiency	.15	55	.04	118	-.11	75
Time Lost	.21	56	-.06	117	-.27	73
Accomplishing Purpose	.31	57	-.04	119	-.35	74
Overall	-.01	56	-.10	111	-.09	67

B. Venetian Blind

Criterion	Pilot vs. Safety Pilot Mean Diff.	N	Pilot vs. Both Mean Diff.	N	Safety Pilot vs. Both Mean Diff.	N
Safety	.50	14	1.12*	18	.62	12
Comfort	-.10	14	-.23	18	-.13	12
Proficiency	.15	14	-.41	18	-.56	12
Time Lost	.65	14	.11	17	-.54	11
Accomplishing Purpose	.50	13	-.44	17	-.94*	12
Overall	1.00	12	-.19	17	-.81*	11

✓ Positive differences indicate higher evaluations by the first-named group.
The Both group consists of pilots with experience in use of the system as pilot and as safety pilot.
* Difference of doubtful significance. (10% level)

TABLE X

DIFFERENCES IN EVALUATION SCORES
FOR BEAK-TYPE BLUE-AMBER, SNJ HOOD AND
MULTI-ENGINE HOOD ACCORDING TO STATUS
OF RESPONDENTS AT TIME OF USE

(Pilot vs. Both Pilot and Safety Pilot)≠

Criterion	Beak-Type Blue-Amber		SNJ Hood		Multi-Engine Hood	
	Mean Diff.	N	Mean Diff.	N	Mean Diff.	N
Safety	-.73	20	-.16	115	.42	31
Comfort	0	20	.07	114	-.68	31
Proficiency	-.37	19	.05	115	-.28	31
Time Lost	-.02	19	.09	112	-.28	30
Accomplishing Purpose	-.37	19	.45**	113	-.26	31
Overall	-.57	18	.29	107	-.42	27

≠ A positive difference indicates that the system was rated higher by the pilot group.

** Significant difference. (2% level)

originally differentiated. After inspecition of the data, which appear in Table XXVIII of Appendix C, these jobs were combined into three functional categories:

1. Pilot, including students

2. Safety pilot, including check-pilots and instructors

3. Both, including only those classifiable in both categories 1 and 2.

These categories are considered meaningful in all respects relevant to the present study; e.g., the jobs of the instructor and check-pilot are somewhat different, but their needs in simulated blind flying equipment are the same.

Respondents were divided into these status categories and their evaluation responses for the five most-used systems were compared. Table IX shows mean response differences between pairs of categories for Regular Blue-Amber and Venetian Blind. As might be expected, the number of respondent in the second category - Safety Pilot only - was relatively small. It was considered too small in the other systems and was omitted. Table X shows mean differences in evaluation by the first and third groups of Beak-Type Blue-Amber, SNJ Hood and Multi-Engine Hood.

For Regular Blue-Amber, all differences may be accounted for on the basis of chance. In some respects, but not overall, Pilots may tend to rate the system higher than Safety Pilots. Respondents who have used this system in both jobs agreed quite closely with the Pilot group and apparently tended to like Blue-Amber a little better than the Safety Pilot group. All in all, the previously described ratings of Regular Blue-Amber were neither inflated nor deflated by the particular bias of any of these groups.

Three differences are of at least doubtful significance for the Venetian Blind. It is probable that Pilots think the system safer than do those in the Both category. Especially for Accomplishing Purpose and Overall, the Pilot-Safety Pilot group tends to be more favorable to the system than is the group with experience only as safety pilot. This leads one to suspect that actual safety-pilot vision through the blinds is perhaps not as good as it may seem to the pilot. Probably the safety-pilot tends more to allow considerations of safety to influence his views of the system in all respects. From all indications, the Both group rated the system with emphasis on the pilot's point of view.

Pilots definitely rate the SNJ Hood higher for Accomplishing Purpose than do Pilot-Safety Pilot respondents. It will be remembered that the SNJ is chiefly used in training student pilots, so that the Pilot group here is composed chiefly of students. It may be assumed that the

more modest aims of the student are more nearly accomplished with the SNJ Hood than are the aims of the instructor.

Results for Beak-Type Blue-Amber and Multi-Engine Hood indicate no more than that there may be a general tendency (except for the SNJ Hood) for the Both group to rate higher than the other groups.

It is reasonable to assume that those pilots who have used systems as both Pilot and Safety Pilot are better able to evaluate the effectiveness of the systems, since the systems operate differently for pilot and safety-pilot. That they are better <u>able</u> to do so is, of course, no guarantee that they <u>have done</u> so in the present sample. The results indicate that these respondents <u>may</u> have emphasized one aspect of the needs with respect to simulated blind flying equipment over the other. Nevertheless, it is of interest to compare the evaluations of systems by this group with evaluations by the whole group. Table XI shows the rank orders of the five most-used systems for these two groups. (See also Taole XXIX, Appendix C.)

The most striking difference appears under Accomplishing Purpose. The whole group ranked SNJ Hood first and Venetian Blind last of the five systems; the Pilot-Safety Pilot group ranked Venetian Blind first and SNJ Hood last. Another interesting point is the change of Beak-Type Blue-Amber from fourth to first place in the Overall ratings. (It should be noted that the Pilot-Safety Pilot group here consists of only three respondents.) Some possible reasons for these changes have been discussed above.

CONCLUSIONS

<u>Usefulness of the results.</u> Pilots know more about the characteristics in actual use of simulated blind flying equipment than anyone else. Pilots, however, are not completely objective about the equipment; their particular experiences have prejudiced their views. This is as it should be, and the questionnaire was designed partly to get at these prejudices. But results obtained should be interpreted with the fact clearly in mind that these prejudices are inherent in the data.

A second limitation in the use of pilot opinion is that pilots have different ideas about the requirements of a good simulated blind flying system. No consistent basis for evaluating systems has been presented to pilots. An attempt was made in the present study to obviate this defect by use of the List of Requirements presented as Appendix A. Acceptability to pilots, however - whatever the viewpoint from which pilots evaluate - is an implicit part of this list. Evaluations of systems by pilots provide the primary source of information on this point. These evaluations, together with free comments made by the respondents, also provide indications of what systems <u>might</u> be better accepted if reliable information is disseminated concerning proper use of systems.

Essentially, the aim in obtaining pilot opinions was to delimit the scope of the study. Some systems can definitely be said to be unacceptable to pilots. In addition, since the systems were rated on the basis of

TABLE XI

COMPARATIVE RANK ORDER OF MEAN EVALUATION SCORES OF FIVE SYSTEMS BY ALL RESPONDENTS AND BY RESPONDENTS WHO HAD USED THE SYSTEMS AS BOTH PILOT AND SAFETY PILOT

Safety	Whole Group		Pilot and Safety Pilot	
	Rank	N	Rank	N
RBA	4	127	3	69
BBA	2	22	1	3
VB	3	24	4	8
SNJ	1	119	2	24
HME	5	36	5	14

Comfort	Whole Group		Pilot and Safety Pilot	
	Rank	N	Rank	N
RBA	4	127	4	69
BBA	5	22	5	3
VB	1	24	1	8
SNJ	3	118	3	24
HME	2	36	2	14

Proficiency	Whole Group		Pilot and Safety Pilot	
	Rank	N	Rank	N
RBA	3	125	5	69
BBA	5	21	2	3
VB	2	24	1	8
SNJ	1	119	4	24
HME	4	36	3	14

Time Lost	Whole Group		Pilot and Safety Pilot	
	Rank	N	Rank	N
RBA	5	124	5	67
BBA	2	21	1	3
VB	3	23	3	7
SNJ	1	116	2	24
HME	4	35	4	13

Accomplishing Purpose	Whole Group		Pilot and Safety Pilot	
	Rank	N	Rank	N
RBA	2	126	2	68
BBA	3	21	3	3
VB	5	23	1	8
SNJ	1	117	5	24
HME	4	36	4	14

Overall	Whole Group		Pilot and Safety Pilot	
	Rank	N	Rank	N
RBA	3	118	4	61
BBA	4	20	1	3
VB	2	22	2	8
SNJ	1	111	3	22
HME	5	32	5	11

several criteria, specific areas of pilot satisfaction and dissatisfaction with the systems have been determined. Further work may now concentrate on these areas.

Unacceptable systems. Five systems are considered unacceptable. Pilot opinion in these cases agrees quite well with evaluation on the basis of the List of Requirements, as indicated above. The systems are listed, with brief comments about each:

Beak-Type Blue-Amber. Actually, pilots do not strongly dislike this system; in many respects, they seem to consider it good. But the Cardboard Beak, which operates on the same principle, is much preferred.

Single-Engine Hood. Generally considered unsafe and inefficient.

Multi-Engine Hood. Unsafe in comparison to other systems.

Window Blind. Although quite good from many points of view, this system is again comparatively unsafe.

Red-Green. Good in some respects, but considered inferior to its successor, Blue-Amber.

Acceptable systems. The remaining four systems (of those for which usable data were available) were indicated to be acceptable to pilots. These systems are:

1. Cardboard Beak
2. SNJ Hood
3. Venetian Blind
4. Regular Blue-Amber

As has been indicated, opinions differed widely, so that "general" acceptance of a system should not be taken as universal acceptance. Some evidence is at hand that pilots become more favorable toward a system with increased use of the system. This relationship was to be expected; pilots need to become accustomed to the necessary restrictions and adapted to the visual changes implicit in any system before they can accept it as a normal part of flying.

It is felt that any of these four systems can become at least acceptable to most pilots. This would depend on complete explanation to pilots of the way the system works and the limitations of its functioning. Training is an important factor in pilot acceptance of a system. If this training is not carried on officially, it will be effected - as it has been in the past - through more informal, and often less desirable, channels. With better pilot understanding of a system, misuse of the system will be recognized as such, and not misinterpreted as malfunctioning or ineffectiveness of the equipment.

Recommendation of one of these systems will not be made in this report. The paragraphs below will be confined to discussion of (1) the state of pilot opinion about each system and contributing factors to these opinions, (2) the amenability of the system to improvement and the necessity for improvements, and (3) some indication of the goals which are implicit in particular systems.

Cardboard Beak. Although only a small and possible biased sample of pilots were obtained for this system, it is safe to infer that the system would be generally well-liked if it were more widely used.. Its chief advantages are that it allows almost unobstructed vision for the safety-pilot and that its installation takes very little time. In addition, the pilot has unobstructed vision of instruments and may see outside the plane by merely raising his head or pushing back the beak. The pilot can often not, however, see all the instruments; and the necessity for maintaining a constant head position may be especially wearing to the pilot since he knows it is so easy to "peek". Other disadvantages are the possibility of physical injury to equipment or personnel, the discomfort of equipment around the head, and the difficulty of storage of equipment in single-engine planes.

The latter conditions can probably be alleviated to a great extent by improved design of the equipment. The other disadvantages appear to be unavoidable. Users of the system assume that the use of all instruments is not necessary for instrument flying practice and that all pilots are temperamentally capable of monitoring their own actions*. In view of the opinions of some flight instructors, it is doubtful if these assumptions can gain universal acceptance. Use of the system would probably need to be limited to situations in which no evaluation is being made of flying skill.

SNJ Hood. It has been seen that this system is well-liked by pilots as a whole, though perhaps less popular among those whose experience has provided a clear-cut basis for comparison of it with other systems. Its advantages are simplicity and adaptability. It is likely that some of its poorer engineering features could be ironed out rather easily.

The SNJ Hood is adaptable in two ways to varying goals of instrument practice. First, the use of partially transparent materials in place of the usual canvas is easily possible, so that partial blackout for the pilot may be effected. Second, the quick-release feature, if improved, would provide for use of the system to simulate alternating blind and contact flight.

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* It should be noted that the second assumption must include subconscious, as well as conscious, control. The role of subconscious or subliminal perception is outside the scope of this study; such perception may not even exist. There is some evidence for it, however, and it is felt that it should not be neglected until its unimportance is demonstrated.

It is felt that this system could be adapted for use in any single-engine aircraft. The weight and volume of the equipment, though not great, might possibly preclude its use in some situations. Conceivably, it could be constructed so that the bulk of the equipment would be removable.

Venetian Blind. Especially in respect to comfort, the Venetian Blind is considered a good system by most pilots who have used it. Since the number of these pilots was somewhat limited in the present study, it should perhaps be pointed out that airline pilots indicated similar opinions in informal interviews. On the whole, more favorable opinions were obtained for this system from pilots with experience as both pilot and safety pilot than from others. Pilot opinion also echoes to some extent the theoretical doubts concerning the safety of the Venetian Blind.

As it is most commonly used, the system blocks the pilot's vision through one window only. Many pilots feel that this is sufficient, since close attention to the instruments is always necessary in piloting a multi-engine plane. If it is desired to occlude more of the window area, the venetian blind principle is difficult to apply, though theoretically possible in many planes. An alternative is to use some sort of curtain, as in the original Delta Airlines system, which was described and pictured in the Phase A report. Either of these possibilities would doubtless be less popular with pilots than the present arrangement.

A promising line of development of the venetian blind principle is the Card or Shield system. Larger and fewer slats are used in this system. As exemplified by ingenious schemes used in a few organizations*, Card or Shield equipment could probably be designed for any multi-engine aircraft so that the pilot's view would be blocked in all directions. Discussion of other features of this system will be reserved for ensuing reports.

It is felt that objective determination is necessary of the extent to which vision by the safety pilot decreases because of the Venetian Blind slats. As indicated previously, this question is not one which can be answered through subjective methods. It would be desirable to have data on either the part of the field of vision occluded by the equipment or the extent to which perception of objects is reduced by it. As far as is known, no such data have been collected. Without objective evidence, this discussion of the Venetian Blind must be incomplete.

Regular Blue-Amber. Although many complaints have been registered against Blue-Amber, general opinion about it is by no means unfavorable. This system is considered by pilots definitely inferior to the Cardboard Beak and SNJ Hood for the criteria Safety and Time Lost, and to the

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* Those investigated in this study include chiefly the systems developed at the CAA Aeronautical Center, Trans-Canada Airlines and NAS, Glenview, Illinois.

Venetian Blind for Comfort. In the other stated aspects - Proficiency and Accomplishing Purpose, which are the criteria directly concerned with the job of obtaining instrument flying practice - and for overall evaluation, Regular Blue-Amber was generally rated lower than these other three systems, though not consistently or significantly lower.

Since a considerable portion of the questionnaire was concerned with detailed determination of various aspects of pilot opinion about this equipment, comment here will be brief. Blue-Amber is effective in any type of aircraft and is adaptable to varying needs in blind flying simulation. It is felt that the system can be improved so that less time is lost and less discomfort experienced. It is probably especially necessary, since the functioning of the system is based on fairly technical principles, to explain the workings and limitations of Blue-Amber in some detail to pilots. Although objective evidence is available on the question of safety-pilot vision through the amber panels, this evidence is not conclusive; or at least it is not accepted as such. Evidence is needed which will relate directly to the safety-pilot's job and which may be stated in terms understandable and immediately useful to pilots.

IV RESULTS - THE BLUE-AMBER SYSTEM

THE METHOD

Responses. It will be recalled that information concerning experiences with the Blue-Amber system was gathered in two areas:

1. Difficulties experienced with the system.
2. Improvements most needed in ths system.

For the second area, responses were made by numbering items in order of rank on the basis of a stated criterion. Rating scales were used for difficulties.

Numbered items. Since the task was such that a respondent did not mark all items, two indices were available:

1. Number of respondents marking each item.
2. Average rank given each item.

For ease in computation and comparison, the second index was altered somewhat. Each rank of 1 was given a score of 5; rank 2 a score of 4; and so forth, up to rank of 5. Any ranks past 5 were disregarded, being contrary to instructions. A few respondents checked items, instead of numbering; in cases where five or fewer items were checked, all such items were given scores of 3. Mean scores were then computed for all items. Thus a high mean improvement score indicates greater need for improvement in the area covered by the item.

Rating scales. To the statement of a particular difficulty with the Blue-Amber system, pilots were asked to respond by answering two questions:

(1) How often does this happen?

(2) How serious are the results of this?

A rating scale was provided for the answer to each question. As before, ratings were converted to numerical scores for analysis. Table XII shows the qualitative and quantitative ratings.

TABLE XII

RESPONSES TO QUESTIONS
CONCERNING DIFFICULTIES

1. How often does this happen?		2. How serious are the results of this?	
Almost Always	3	Very Detrimental	2
Frequently	2	Detrimental	1
Sometimes	1	Negligible	0
Almost Never	0	Actually Helpful	H

An exception should be noted. Responses of Actually Helpful to the second question were not quantified, but were separately designated by the letter H. The response was included in order to cover the possible case in which the statement was not considered a difficulty, but rather an advantage. To a pilot who wants to conduct blind flying practice with only a few instruments, the difficulty: "The goggles restrict the range of vision" was not a difficulty at all. He was able to indicate this opinion by checking Actually Helpful.

In general, an Actually Helpful response meant that the respondent disagreed with some part of the List of Requirements which formed the basis for defining the statements as difficulties. Very few such responses were obtained; so few that they were, as a rule, disregarded. Clearly, it was not logically possible to attach to them a meaning continuous with the meanings of the other responses.

Another sort of response was disregarded: responses to the second question by respondents who had answered Almost Never to the first question. It was desired to have all results based on first-hand experience. If a pilot has never experienced a particular difficulty, he is not qualified by experience to comment on the seriousness of that difficulty. Of course, a response of Almost Never does not necessarily mean never; and experience is not necessarily the only basis of qualification. Some useful data were probably available among these responses. Since, however, it was not possible to recognize the useful responses, it was necessary to disregard all of them.

The two questions. The aim in presenting a number of difficulties to a number of pilots was to determine which difficulties are of prime importance to Naval pilots. Statements of difficulties by individuals would obviously vary in phraseology; it would be difficult - and, in fact, presumptuous - to decide whether any two individuals were talking about the same thing. The difficulties were stated explicitly so that responses would be immediately comparable.

For much the same reason, the questions asked about each difficulty were explicit. Further, the same questions were asked about each

difficulty so that precise comparisons were possible among difficulties. In some cases, these standard questions did not provide all the information wanted, but the nature of the additional information was such that it could be covered by appending a question of the free-response type.

If a particular difficulty with the Blue-Amber system occurs only rarely, it is of little importance for the present purpose - unless its consequences are of a nature which might be critical to the safety of the aircraft and crew. Similarly, if the consequences are not serious, the difficulty is insignificant unless it occurs so frequently as to hamper the pilot or safety pilot in carrying out the job at hand. In general, both frequency of occurrence (first question) and seriousness of results (second question) were taken into consideration in evaluating the relative importance of difficulties.

DIFFICULTIES

Blue goggles. With the exception of "homemade" devices grouped generally under the heading of sun glasses, only three types of blue eye-covering are extensively used by Navy pilots. These are listed according to the letter codes used in the questionnaire together with the number of respondents using each:

A. Brow-rest (67)
B. Snug type (103)
F. Visor (61)

Table XIII shows, for these three types of goggles, mean scores on the two questions asked about each of the thirteen listed difficulties.

From consideration of the data in the table, it is reasonable to consider of prime importance those difficulties for which mean scores on both questions are 1.00 or greater. It may be noted that this situation occurs in four cases for the snug type, twice for the visor, and not at all for the brow-rest. The chief difficulties appear to be fogging (1), restriction of vision (6), and general instrument vision (7). Secondary in importance are discomfort from fastenings (10) and perspiration (11). Of interest also are the high Frequency scores for scratching (2) and accumulating dirt and dust (3). Although the consequences of these purely physical difficulties do not appear to pilots to be serious, it may be suspected that there are indirect consequences which are reflected in other Seriousness scores, especially that of general instrument vision.

From the free comments by pilots about blue goggles, several points were noted to modify the above results. A great many comments concerned physical discomfort or inconvenience due to fastenings of the various goggles. Earphones, in particular, press down on the earpieces of brow-rest goggles and on the overhead and side supports of the visor; and cause difficulty in putting on and removing goggles. Pilots often wear the goggles for periods of two hours or longer. Obviously, minor irritations will assume large proportions over this period of time.

Much dissatisfaction with adequacy of instrument vision stems from reflections and glare which come not from the goggles, but from the amber panels and instruments. Part of the solution to this particular difficulty may be in provision for some sort of sun shield attached to or worn with goggles. In contrast to difficulties due to too much light, other comments mention that instrument vision is particularly unsatisfactory when the outside brightness is low. It is likely that Blue-Amber is often used, contrary to instructions, in overcase weather and at dawn or dusk. More emphasis on the danger involved in using the system at these times appears to be needed. Even so, some sort of supplementary artificial light may be indicated.* Pilots generally indicate that use of instrument lights is not helpful; the gain in illumination obtained by leaving some windows clear of amber material may be offset by a concomitant increase in reflections. Despite the fact that pilots are somewhat aware of the need for dark adaptation in other situations, most respondents did not consider a period of adaptation to reduced light necessary or even desirable with the Blue-Amber system. Respondents who did consider a dark adaptation period desirable talked in terms of a few seconds or, at the most, two or three minutes.

Preference among goggles. Incidentally to the collection of information about usage of goggles, pilots were asked to specify the rank order of preference of the three goggles they had used most. It is of interest to consider the resulting data at this point, as a check on the apparent preferences noted above. In Table XIV are shown percentages, for each goggle type, of respondents indicating each order of preference. Respondents using three or more types are treated separately from those using only two, since their responses are not directly comparable.

Clearly, the brow-rest type is preferred. Probably, the visor is slightly better-liked than the snug type. Preference for the visor is based, in many cases, on the fact that it may be raised away from the face so that a clear view of the instruments is obtained. If this is done, the system is the Beak-Type Blue-Amber system; it has been previously concluded that this system is relatively inefficient compared to the Cardboard Beak. Some pilots, especially those experienced chiefly in single-engine aircraft, prefer the snug type goggles because the elastic band may be used to suspend them around the neck when not in use.

With a few improvements, the brow-rest type would doubtless be acceptable to all pilots. One of these improvements might be to substitute an elastic band for the ear pieces now used. Not only would this allow pilots to suspend the goggles around the neck, but it would also prevent difficulties with earphones. Use of softer material around the ears and bridge of the nose would also be desirable. Some weight on the

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* See BEEBE-CENTER, J.G., HOFFMAN, A.C., MEAD, L.C., WAGONER, L.S., and WATERHOUSE, B.R. Vision through blue and amber filters. Report No. 23; Laboratory of Sensory Psychology and Physiology, Tufts College, Medford, Massachusetts, August 30, 1944, p. 36.

TABLE XIII

FREQUENCY OF OCCURRENCE AND SERIOUSNESS OF CONSEQUENCES OF THIRTEEN SUGGESTED DIFFICULTIES WITH THREE TYPES OF BLUE GOGGLES

Difficulty	Goggle Type A=Brow-rest B=Snug Type F=Visor	Frequency Mean	Frequency N	Seriousness Mean	Seriousness N
1. The goggles (or visor) get fogged up.	A	.56	57	.67	23
	B	1.53	89	1.31	67
	F	.81	42	1.08	18
2. The blue acetate gets scratched.	A	1.28	57	.59	44
	B	1.49	86	.62	71
	F	1.51	41	.67	30
3. The blue acetate gets dirty or dusty.	A	1.29	56	.50	44
	B	1.40	84	.54	71
	F	1.38	39	.78	32
4. There are imperfections in the blue acetate.	A	.23	52	.22	9
	B	.25	79	.53	15
	F	.29	35	.25	8
5. Vision through the blue is distorted.	A	.53	55	.78	18
	B	.43	79	.88	24
	F	.61	41	.87	15
6. The goggles restrict the range of vision.	A	1.00	58	.97	35
	B	1.37	83	.98	58
	F	1.31	42	1.07	30
7. In general, vision of the instruments through the blue is poor.	A	1.07	57	.97	39
	B	1.18	84	1.12	52
	F	1.40	42	1.19	27
8. Reflections appear in the blue acetate.	A	.72	68	.73	40
	B	.90	72	.74	47
	F	.95	39	.69	26
9. Eyestrain results from using blue goggles.	A	.59	64	.83	29
	B	1.01	74	1.02	46
	F	.88	40	.80	20
10. Discomfort is caused by the straps or bands or earpieces used to fasten goggles to the head.	A	1.18	68	.98	45
	B	1.60	75	.94	52
	F	1.56	41	.97	30
11. The goggles cause excessive perspiration.	A	.95	66	.89	35
	B	1.61	75	1.04	62
	F	1.26	35	.98	24
12. It is difficult to remove goggles quickly when necessary.	A	.77	66	.79	29
	B	.79	75	.89	38
	F	1.14	37	.95	21
13. The shade of blue used in the goggles is depressing.	A	.25	61	.56	9
	B	.37	63	.58	12
	F	.36	33	.67	6

TABLE XIV

PERCENTAGES OF USERS OF EACH OF THREE
TYPES OF GOGGLES RANKING THE TYPE
IN VARIOUS ORDERS OF PREFERENCE

A. Respondents Using Three or More Types

	Goggle Type		
	Brow-rest	Snug type	Visor
No. of respondents	35	32	27
Order of preference			
First	68.6	15.6	11.1
Second	25.7	25.0	51.9
Third	5.7	59.4	37.0

B. Respondents Using Two Types

	Brow-rest	Snug type	Visor
No. of respondents	20	37	21
Order of preference			
First	85.0	37.8	42.9
Second	15.0	62.2	57.1

nose appears necessary, since the goggles must cover a large area of the face in order to cut out direct external light and annoying reflections.

Amber panels. Scores for thirteen possible difficulties with amber panels appear in Table XV. Difficulties of primary importance are scratching (3) and general outside vision (11). Collecting dirt and dust (5) and installation and removal time (9) are also scored fairly high.

Pilots typically indicated that more careful handling, better stowage arrangements and more efficient methods of installation would help greatly to improve effectiveness of amber panels. A common suggestion was that the installations be made standard for a particular type of aircraft. With typical methods of fastening, the panels are often scratched when they are rubbed against various surfaces in the normal course of installation or when they are placed or thrown on the floor rather than stowed in a canvas bag, or when the propellor airstream loosens the panels from their moorings. Even with improved, standard installations, many pilots think they would not be completely satisfied with the amber panels. Some of this dissatisfaction may be due, as in the case of goggles, to use of the Blue-Amber system when external brightness is too low. Pilots do not necessarily agree with official statements that amber acetate improves vision in haze. Many think just the opposite. It should be remembered that the statement holds (if it holds at all) only in normal daylight brightness. Use of amber panels may well be dangerous in haze accompanied by a partial overcast.

General difficulties. Four difficulties with the Blue-Amber system which cannot be attributed to either blue goggles or amber panels are shown in Table XVI. Reflections in instrument faces appear to be significantly detrimental to usefulness of the equipment.

Pilots say that reflections blind them or obscure the instruments momentarily. Reflections occur in the instrument faces only when the sun is at particular angles, chiefly to the side and rear of the plane. Particularly during banking turns, the sun is likely at some point to be at the "correct" angle to disrupt practice. Use of amber panels on all windows apparently prevents these reflections. But this procedure may cause the cockpit to become extremely warm and may cut down the brightness of the light so that instrument vision is difficult. With secure fastening of panels, however, it would be possible to open a side window part way for partial air circulation. In many planes, enough light is available from the rear for adequate instrument vision; in others, supplementary artificial light may be necessary. The alternatives to full amber coverage are use of movable opaque shields and restriction of maneuvers to avoid the critical angles. Neither of these is a satisfactory solution.

Although reflections from blue goggles and from amber panels were not considered of primary importance, the three sources of reflections constitute together a serious threat to the efficiency of the simulated blind flying equipment. All reflections depend on entrance of unfiltered light into a relatively dark cockpit. If all light which might produce a blinding

TABLE XV

FREQUENCY OF OCCURRENCE AND SERIOUSNESS
OF CONSEQUENCES OF THIRTEEN SUGGESTED
DIFFICULTIES WITH AMBER PANELS

Difficulty	Frequency Mean	Frequency N	Seriousness Mean	Seriousness N
1. The amber gets fogged up.	.29	118	.93	27
2. The amber cracks.	1.35	119	.83	89
3. The amber gets scratched.	1.72	121	1.00	99
4. The amber bends and gets warped.	1.26	121	.70	86
5. The amber collects dirt and dust.	1.35	120	.91	88
6. There are imperfections in the amber.	.41	111	.85	31
7. After it has been used for some time, the amber fades.	.71	98	.53	34
8. Amber panels do not fit closely along the edges of the windscreen.	1.39	121	.56	91
9. Installation and removal of amber panels are excessively time-consuming.	1.52	122	.69	85
10. Reflections appear in the amber.	.89	114	.68	65
11. Through amber alone, vision outside the plane is poor.	1.87	116	1.40	96
12. With amber alone installed, vision of instruments is poor.	.27	106	.52	21
13. The shade of amber used is disturbing.	.15	103	.44	9

TABLE XVI

FREQUENCY OF OCCURRENCE AND SERIOUSNESS OF CONSEQUENCES OF FOUR SUGGESTED GENERAL DIFFICULTIES WITH THE BLUE-AMBER SYSTEM

Difficulty	Frequency Mean	Frequency N	Seriousness Mean	Seriousness N
1. Unusually bright reflections appear in the instrument faces.	1.02	101	1.06	62
2. Installation of blue-amber equipment makes the cockpit hot and stuffy.	.78	108	.78	46
3. The blue-amber equipment causes a closed-in feeling.	.70	105	.62	37
4. It is distracting to know that "cheating" is possible with the system.	.53	106	.91	34

TABLE XVII

FREQUENCY OF OCCURRENCE AND SERIOUSNESS OF CONSEQUENCES OF FOUR SUGGESTED DIFFICULTIES WITH THE BEAK-TYPE BLUE-AMBER SYSTEM

Difficulty	Frequency Mean	Frequency N	Seriousness Mean	Seriousness N
1. The beak gets in the way and bumps into things.	2.00	28	.92	24
2. The beak interferes with vision of some instruments.	1.33	27	1.67	15
3. It is tiring to wear the (heavy)* beak.	1.54	28	1.22	18
4. Wearing the beak involves holding the head unnaturally still.	1.27	26	1.11	18

* The word "heavy" was omitted from the questionnaire as used at Norfolk. Means are shown separately for Corpus Christi and Norfolk respondents in Table XXXII, Appendix C.

TABLE XVIII

FREQUENCY OF MARKING AND MEAN RATING SCORE OF TEN ITEMS LISTED AS POSSIBLE IMPROVEMENTS IN THE BLUE-AMBER SYSTEM

	Improvement	Number of respondents rating	Mean rating score*
1.	Change the color of the amber.	10	2.4
2.	Improve the durability of the amber.	64	2.8
3.	Make installation and removal of the amber easier.	84	3.4
4.	Change light transmitting qualities of amber to improve vision through it.	76	3.8
5.	Change the color of the blue.	14	2.9
6.	Redesign goggles to make them more comfortable.	70	3.4
7.	Redesign goggles to improve vision through them.	58	2.9
8.	Revamp installation practices to get more light in the cockpit.	36	2.8
9.	Change blue and/or amber to increase vision through both.	35	3.1
10.	Change blue and/or amber to decrease vision through both.	4	2.5

* Rank of 1 equals score of 5, rank 2 = socre 4, 3 = 3, 4 = 2, 1 = 5.

TABLE XIX

FREQUENCY OF MARKING OF IMPROVEMENTS LISTED BY RESPONDENTS AS DESIRABLE IN THE BLUE-AMBER SYSTEM

	Improvement	Number of respondents listing
1.	Provide supplementary lighting for better vision through blue.	3
2.	Eliminate goggles.	1
3.	Provide for easier removal of goggles.	2
4.	Improve quality of amber to make it distortion-free.	1
5.	Provide standardized equipment.	3
6.	Install amber permanently.	1
7.	Revamp installation or other practices to eliminate excessive light and glare in cock-pit.	5
8.	Prevent fogging of amber.	1
9.	Improve information services to field units.	1
10.	Reduce reflections.	1
11.	Improve storage practices.	1
12.	Change installation practices to prevent warping of amber.	1
13.	Prevent fogging of goggles.	1
14.	Design panels to fit cockpit better.	1
15.	Fasten amber panels more securely.	1

reflection is filtered through amber, these difficulties should disappear.

Beak-Type Blue-Amber. Table XVII shows results for four difficulties with this system. All four may be considered to be of primary importance. It should be pointed out, however, that these are more "selected" than those applying to Regular Blue-Amber. Doubtless, if only four difficulties had been chosen to represent the latter system, the Frequency and Seriousness scores would have turned out to be just as high as those in Table XVII. Nevertheless, Beak-Type Blue-Amber is beset with these particular difficulties, and very likely with others. Incidentally, the four difficulties apply equally well to the Cardboard Beak.

IMPROVEMENTS

Improvements listed in questionnaire. The ten possible improvements listed in the questionnaire were intended not to be comprehensive, but to cover the general areas amenable to change and to suggest to respondents other items. The number of respondents giving any rating to each of the ten items and the mean rating score for each appear in Table XVIII.

Although several of the improvements were frequently rated, it appears that three are clearly the most wanted. These are: easier installation and removal (3), improved vision through amber (4), and more comfortable goggles (6). Pilots do not want the amber and blue colors changed, nor do many of them feel that more light in the cockpit and more or less vision through both blue and amber are of prime importance.

Improvements listed by respondents. Table XIX provides a list of improvements suggested by pilots, together with the number of pilots suggesting each. Some rewording of suggestions was necessary in order to combine those of the same general tenor, but an attempt was made to refrain from arbitrarily reading more or less into the suggestion than had been intended. One interesting result is that few pilots have definite enough ideas concerning Blue-Amber to suggest other improvements than those listed.

Several of the suggestions, however, are helpful indications of the directions in which pilots feel developmental work on Blue-Amber should progress. In general, the suggestions are slanted towards improvement of the blue and amber materials or of practices in installation and removal of amber panels. Three pilots wanted the equipment to be standardized for plane types. Of particular interest is the item: Improve information services to field units. The pilot who made this suggestion had encountered unusual difficulties in attempting to obtain Blue-Amber materials and information about their use for his squadron. Probably this unit was unique in having difficulty obtaining materials. But it is felt that many units do not receive adequate information concerning usage and limitations of the Blue-Amber equipment.

CONCLUSIONS

Six points will serve to summarize those features of Blue-Amber which Navy pilots apparently consider most important.

1. Although the brow-rest goggles are preferred to other common types, they are somewhat uncomfortable and tend to restrict vision to a few instruments at a time.

2. It is somewhat difficult to see the instruments clearly through any type of blue goggles.

3. An especial difficulty with amber panels is that they become scratched easily, though careful handling can prevent much of this damage.

4. Vision outside the aircraft through amber panels is often considered unsatisfactory.

5. Difficulty in installing and removing amber panels is a major obstacle to satisfaction with the system, even though the time lost thereby is not considered important in comparison with other difficulties.

6. Blinding reflections, especially those from the instrument panels, often cause serious interruption of instrument flying practice.

Although separate points of difficulty with Blue-Amber may be designated, any such division of function or operation is somewhat arbitrary since the functions overlap and interact. For example, consider the problem of the amount of window area to be covered by amber panels. If fewer windows are covered, the pilot will have better vision of the instruments. But he will also see more outside the aircraft. Further, with more unfiltered light entering the cockpit, the danger of blinding reflections will be greater. Many such situations may be enumerated in which there are conflicting needs in design of equipment.

At the same time, if the system does not work satisfactorily in one respect, it is then considered unsatisfactory in other respects. Conversely, it will generally be true that a real improvement in structure or use of any part of the equipment will be reflected in other aspects of the scheme and in increased pilot confidence in the usefulness of the Blue-Amber system.

APPENDIX A

REQUIREMENTS FOR EQUIPMENT USED TO SIMULATE BLIND FLYING

A PROPOSED LIST OF
REQUIREMENTS FOR EQUIPMENT USED
TO SIMULATE BLIND FLYING

1. Blackout. The pilot should be able to see outside the plane to only a limited extent. (Ideally, this would mean he could see nothing at all. Practically, he might be able to see a limited amount with some effort. But he should not be confronted with the distraction of knowing that vision outside the plane is possible. And, in any event, he should not have vision of landmarks or the horizon.)

2. Check-pilot Vision. The check-pilot should have a good view outside the plane. (That is, he should be able to see as well as he normally could as co-pilot.)

3. General Safety. The apparatus should not be in any way unsafe. (In detail, this should include provisions that it will not (1) interfere with provisions for bailing out, (2) interfere with the opening of any windows which can ordinarily be opened, (3) have sharp edges or dangerous projections, (4) be insecurely fastened so that it might fall and interfere with controls and/or injure personnel, (5) vibrate or flap in the wind so as to obscure instruments or distract the pilot.)

4. Vision of Instruments. Both pilot and check-pilot should have a clear view of all necessary instruments. (For the check-pilot, this should apply unequivocally and should include all instruments, for the sake of safety. The pilot's vision of the instruments may be cut down somewhat, as long as his proficience is not impaired because he cannot read the instruments. Also, although it is highly desirable that the pilot be able to read all instruments, it is not absolutely necessary in the case of some of the less essential ones, especially the overhead instruments.)

5. Comfort. Equipment should not cause discomfort or feelings of insecurity on the part of those who use it.

6. Convenience in Handling. The apparatus should be of such size, weight and shape that it may be handled conveniently. (Provision for safe and adequate storage of the apparatus in the plane should be easy to make.)

7. Installation. Equipment should be such that it can be put into operation and removed from operation in a short time while in the air. (It should be possible to tear it down in two or three seconds in an emergency.)

8. Non-fragility. The equipment should remain usable after rough handling and exposure to all normal weather conditions.

9. Modification of Plane. Equipment permanently installed in the plane should not be so extensive or so complicated that modification of the plane requires substantial investment of time and effort.

10. Flexibility. The equipment should be such that it may be adapted for different aircraft and for differences in the same type of aircraft, and that it may be modified to meet possible changing needs in instrument flying procedures.

APPENDIX B

THE QUESTIONNAIRE

Changes in the Questionnaire

The questionnaire as used at Norfolk is reproduced beginning on page B-3 of this appendix. Nine changes in content had been made in the form as it had been administered at Corpus Christi. These changes are listed below. For convenience, they are stated as instructions for changing the Norfolk questionnaire back to its original form. The format is shown essentially as in the original questionnaire, although space requirements of this report make exact reproduction impossible.

To reproduce, then the questionnaire used at Corpus Christi, perform the following operations on the Norfolk form:

(1) Page 3, top left. Delete:
Repeat here the numbering on the previous page under "Order of Use":

____a. Brow-rest	____e. Sun glasses
____b. Snug type	____f. Visor
____c. Non-fogging	____g.
____d. Ski-type	____h.

(2) Page 3, item 6. Change:
From: The goggles restrict the range of vision.
To: Vision through the blue is restricted.

(3) Page 3, under item 7. Change:
From: Is it necessary to wear goggles for several minutes before you can see the instruments?
To: Is a period of adaptation necessary before you can see the instruments?

(4) Page 4, top left. Delete as in (1) above.

(5) Page 4, under item 11. Delete:
What are they?

(6) Page 6, under item 10. Delete:
(Under what conditions does it happen?)

(7) Page 7, Beaks, item 3. Change:
From: It is tiring to wear the beak.
To: It is tiring to wear the heavy beak.

(8) Page 7, General, under item 1, first question. Delete:
When does it happen?

(9) Page 8, Improvements, item 7. Change:
From: Redesign goggles to improve vision through them.
To: Redesign goggles for increased visual efficiency.

AMERICAN INSTITUTE FOR RESEARCH

October 28, 1948

SURVEY OF PILOT EXPERIENCE WITH METHODS OF SIMULATING BLIND FLYING

PERSONAL INFORMATION

1. What is your present rank?______

2. What is your present job or status?____________________

3. How many hours (approximately) have you flown, total? ________
   , actual instruments? ________
   , simulated instruments?________

PART I The Blue-Amber System

A. DESCRIPTION

Regular Blue-Amber (with amber window panels)

1. In what plane or planes did you use it?____________________
2. In what year did you last use the system?__________
3. Approximately how many flying hours with the system?__________
4. What was your status? (Check one or more.)
   - Student ____
   - Instructor ____
   - Pilot ____
   - Check-pilot ____
   - Other (specify): ____
5. At what location or locations have you used it?__________
6. What windows were covered? (For single-engine aircraft, approximate this by checking the directions in which there was coverage.)
   - Left Front ___ Left Rear ___
   - Right Front ___ Right Rear ___
   - Left Side ___ Overhead ___
   - Right Side ___ Other: ___
7. Did you use the instrument lights?
   Always___ Sometimes___ Never___
8. Did you use other artificial light in the cockpit?
   Always___ Sometimes___ Never___
9. Describe any special features of the system:

****

Beak-Type Blue-Amber (with amber glass attached to goggles or Headband)

1. Plane __________
2. Year last used __________
3. Hours used __________
4. Status: Student ____
   - Instructor ____
   - Pilot ____
   - Check-pilot ____
   - Other (specify):
   ____
5. Location:
   ____
6. Instrument lights?
   - Always ___
   - Sometimes ___
   - Never ___
7. Other artificial lights?
   - Always ___
   - Sometimes ___
   - Never ___
8. Describe any special features of the system:

Goggles

Below are listed six kinds of goggles (or, strictly speaking, "eye-coverings") which are sometimes used in simulated instrument flying. You are asked to supply information in four places.

1. Fill in short descriptions of any other eye-covering you have had experience with. Use spaces g and h at the end of the list.
2. In the column at the left labeled "Order of use," place the number 1 opposite the goggle which you have used most, 2 opposite the one used second most, and 3 for the third. (Number only three.)
3. In the next column, number these same three goggles in the order of your preference among them.
4. In the spaces to the right, check the appropriate column for all goggles.

Order of use	Order of Preference	Kinds of goggles	Never used	Less than 10 hours	10-50 hours	More than 50 hours
		a. Brow-rest				
		b. Snug type (rubber framed "all-purpose")				
		c. Non-fogging (X-Vent)				
		d. Ski-type				
		e. Sun glasses				
		f. Visor				
		g.				
		h.				

Do you have any particular reason for your preferences? Or would you prefer to try out some type of goggle which you haven't yet used? Please comment below.

****

B. DIFFICULTIES WITH BLUE-AMBER

In this section (which begins on the next page), we have listed a number of statements which may or may not be true about the blue-amber system. These statements are enclosed and are followed by rows of boxes in which check marks are to be made to answer the two questions: (1) How often is this true? (2) How serious are the results of this? These questions and four answers for each are stated at the top of each page. You are asked to check the answer most closely corresponding to your opinion. Please check the answer to at least the first question for all statements, unless you have never had a chance to observe whatever is described. (For example, you can't answer any of the questions about the Beak-Type if you have never used it.) Notice that there are three boxes for the questions about goggles. For these, answer with respect to each of the three goggles you have used most, in the order you indicated at the top of this page. (If you haven't used as many as three, disregard the extra box or boxes.)

In addition, there are questions asking for details about many of the points. It is not at all necessary to answer every one of these questions. We will, however be happy if you can shed any light on these matters on the basis of your experience. You can do this by answering the questions or by commenting without regard for the questions. Space has also been left after items which have no questions attached, so that you can make comments of any nature.

Blue Goggles

Repeat here the numbering on the previous page under "Order of Use":

___ a. Brow-rest	___ e. Sun glasses
___ b. Snug type	___ f. Visor
___ c. Non-fogging	___ g.
___ d. Ski-type	___ h.

		How often does this happen?				How serious are the results of this?			
		Almost Always	Frequently	Sometimes	Almost Never	Very Detrimental	Detrimental	Negligible	Actually Helpful
1. The goggles (or visor) get fogged up.	1								
What have you found is the best way	2								
to prevent fogging?	3								
2. The blue acetate gets scratched.	1								
In what other ways does the blue	2								
get damaged?	3								
If damage occurs, what are the chief causes?									
3. The blue acetate gets dirty or dusty.	1								
	2								
	3								
4. There are imperfections in the blue	1								
acetate.	2								
	3								
5. Vision through the blue is distorted.	1								
If there is distortion, what is the	2								
cause?	3								
6. The goggles restrict the range of	1								
vision.	2								
Is it difficult or impossible to	3								
overhead dials and controls?									
7. In general, vision of the instruments	1								
through the blue is poor.	2								
Where, specifically, does this	3								
difficulty lie?									

Is it necessary to wear goggles for several minutes before you can see the instruments?

Fill in the same numbers again:

___a. Snug type	___e. Sun glasses
___b. Brow-rest	___f. Visor
___c. Non-fogging	___g.
___d. Ski-type	___h.

		How often does this happen?				How serious are the results of this?			
		Almost Always	Frequently	Sometimes	Almost Never	Very Detrimental	Detrimental	Negligible	Actually Helpful
8. Reflections appear in the blue acetate. What can be done to prevent this?	1								
	2								
	3								
9. Eyestrain results from using blue goggles. Under what conditions does this happen? Do headaches ever result from this?	1								
	2								
	3								
10. Discomfort is caused by the straps or bands or earpieces used to fasten goggles to the head.	1								
	2								
	3								
11. The goggles cause excessive perspiration. Are there serious consequences resulting from perspiration? What are they?	1								
	2								
	3								
12. It is difficult to remove goggles quickly when necessary.	1								
	2								
	3								
13. The shade of blue used in the goggles is despressing. If depressing, what shade would you prefer?	1								
	2								
	3								

(List in the space below (1) any other difficulties you have had with blue acetate and/or with goggles or (2) any recommendations or suggestions you would like to make on this subject.)

Amber	How often does this happen?				How serious are the results of this?			
	Almost Always	Frequently	Sometimes	Almost Never	Very Detrimental	Detrimental	Negligible	Actually Helpful
1. The amber gets fogged up.								
If so, under what conditions does it happen?								
2. The amber cracks.								
Does this depend on weather conditions? climate?								
Would more careful handling prevent this?								
3. The amber gets scratched.								
How does this affect vision through the amber alone?								
4. The amber bends and gets warped.								
Does this depend on weather conditions? climate?								
How does this affect vision through the amber alone?								
5. The amber collects dirt and dust.								
What changes in maintenace procedures would help?								
How does this affect vision through the amber alone?								
6. There are imperfections in the amber.								
How does this affect vision through the amber alone?								
7. After it has been used for some time, the amber fades.								
Does this depend on storage practices?								

	How often does this happen?				How serious are the results of this?			
	Almost Always	Frequently	Sometimes	Almost Never	Very Detrimental	Detrimental	Negligible	Actually Helpful
8. Amber panels do not fit closely along the edges of the windscreen.								
9. Installation and removal of amber panels are excessively time-consuming.								
10. Reflections appear in the amber.								
11. Through amber alone, vision outside the plane is poor.								
12. With amber alone installed, vision of instruments is poor.								
13. The shade of amber used is disturbing.								

Item 9 — How can this be corrected?

Item 10 — What can be done to prevent this? (Under what conditions does it happen?)

Item 11 — Is this particularly true in some particular flying situation (landing, takeoff, etc.)?

Does this vary with weather conditions?

Does eyestrain result from this? headaches?

Item 12 — What can be done to improve this vision?

Item 13 — If so, what shade would you prefer?

Would you prefer to use blue in the windscreen and amber goggles?

(List below any other difficulties and recommendations about amber.)

Beaks

	How often does this happen?				How serious are the results of this?			
	Almost Always	Frequently	Sometimes	Almost Never	Very Detrimental	Detrimental	Negligible	Actually Helpful
1. The beak gets in the way and bumps into things.								
2. The beak interferes with vision of some instruments.								
3. It is tiring to wear the beak.								
4. Wearing the beak involves holding the head unnaturally still.								

(State other comments about the beak.)

****

General

1. Unusually bright reflections appear in instrument faces.								

What are the consequences of this? When does it happen?

What can be done to prevent this?

2. Installation of blue-amber equipment makes the cockpit hot and stuffy.								
3. The blue-amber equipment causes a closed-in feeling.								
4. It is distracting to know that "cheating" is possible with the system?								

Improvements

Several organizations have attempted to make improvements in the blue-amber system. Others probably will do so in the future. What particular aspects of the system would you like most to have improved?

To answer, first read over the suggestions below and add others which you feel are important. Then, place numbers to the left of five areas, to indicate those you would most like to have improved. Start with the number 1 for your first choice.

__1. Change the color of the amber.
__2. Improve the durability of the amber.
__3. Make installation and removal of amber easier.
__4. Change light transmitting qualities of amber to improve vision through it.
__5. Change the color of the blue.
__6. Redesign goggles to make them more comfortable.
__7. Redesign goggles to improve vision through them.
__8. Revamp installation practices to get more light in the cock-pit.
__9. Change blue and/or amber to increase vision through both.
__10. Change blue and/or amber to decrease vision through both.
__11.
__12.
__13.
__14.
__15.

Part II Other Systems

Fill in below and on the next page information about all systems you have actually used in flight.

Hood (in SNJ only)
1. Plane __
2. Year last used __
3. Hours used __
4. Status: Student __
Instructor __
Pilot __
Check-pilot __
Other (specify):
5. Instrument lights?
Always __
Sometimes __
Never __
6. Other artificial light?
Always __
Sometimes __
Never __
7. Describe any special features?

Hood (in other planes)
1. Plane __
2. Year last used __
3. Hours used __
4. Status: Student __
Instructor __
Pilot __
Check-pilot __
Other (specify):
5. Instrument lights?
Always __
Sometimes __
Never __
6. Other artificial light?
Always __
Sometimes __
Never __
7. Describe any special features?

Fill in any other systems you have used in the blank spaces (Red-Green, Venetian Blind, Card or Shield system, Window Blind, etc.)

____
(name of system)

Plane ____
Year last used ____
Hours used ____
Status: Student ____
Instructor ____
Pilot ____
Check-pilot ____
Other (specify):

Instrument lights?
Always ____
Sometimes ____
Never ____

Other artificial light?
Always ____
Sometimes ____
Never ____

Describe the system briefly:

****

____
(name of system)

Plane ____
Year last used ____
Hours used ____
Status: Student ____
Instructor ____
Pilot ____
Check-pilot ____
Other (specify):

Instrument lights?
Always ____
Sometimes ____
Never ____

Other artificial light?
Always ____
Sometimes ____
Never ____

Describe the system briefly:

****

____
(name of system)

Plane ____
Year last used ____
Hours used ____
Status: Student ____
Instructor ____
Pilot ____
Check-pilot ____
Other (specify):

Instrument lights?
Always ____
Sometimes ____
Never ____

Other artificial light?
Always ____
Sometimes ____
Never ____

Describe the system briefly:

____
(name of system)

Plane ____
Year last used ____
Hours used ____
Status: Student ____
Instructor ____
Pilot ____
Check-pilot ____
Other (specify):

Instrument lights?
Always ____
Sometimes ____
Never ____

Other artificial light?
Always ____
Sometimes ____
Never ____

Describe the system briefly:

Rate below each system you have described on the previous pages. Make your rating on the basis of how well you think the system meets the particular aspect of requirements of a good system. Two of the aspects need some explanation: Time Lost, which refers to time spent in handling, installing and adjusting the equipment — time which might better have been spent in flying; and Accomplishing Purpose, which is a shorthand way of asking how well the system allows you to accomplish your purpose, which is to develop or maintain proficiency in flying instruments. Note, too, that the Overall rating will not necessarily be an average of the others; you should take into account all aspects of the requirements for a good system (we may have overlooked some).

Regular Blue-Amber
(with amber window panels)

	Very Good	Good	Fair	Poor	Very Poor
Safety					
Comfort					
Proficiency					
Time Lost					
Accomplishing Purpose					
Overall					

Beak-Type Blue-Amber

	Very Good	Good	Fair	Poor	Very Poor
Safety					
Comfort					
Proficiency					
Time Lost					
Accomplishing Purpose					
Overall					

Hood (in SNJ)

	Very Good	Good	Fair	Poor	Very Good
Safety					
Comfort					
Proficiency					
Time Lost					
Accomplishing Purpose					
Overall					

(name of system)

	Very Good	Good	Fair	Poor	Very Good
Safety					
Comfort					
Proficiency					
Time Lost					
Accomplishing Purpose					
Overall					

(name of system)

	Very Good	Good	Fair	Poor	Very Good
Safety					
Comfort					
Proficiency					
Time Lost					
Accomplishing Purpose					
Overall					

(name of system)

	Very Good	Good	Fair	Poor	Very Good
Safety					
Comfort					
Proficiency					
Time Lost					
Accomplishing Purpose					
Overall					

Think of the most recent situation which best illustrates why you feel as you do about some particular system. Please describe below just what happened and indicate specifically what feature of the equipment was involved.

1. Do you have any recommendations to make for possible ways of improving any system?

2. Other comments?

APPENDIX C

TABLES PROVIDING SUPPLEMENTARY DATA

TABLE XX

HOURS OF ACTUAL INSTRUMENT AND SIMULATED INSTRUMENT FLIGHT BY RESPONDENTS OF VARIOUS PRESENT MILITARY RANKS

A. Actual Instrument Conditions

Hours Flown	Rank: AC	ENS. (2nd Lt.)	LT.(jg) (1st Lt.)	LT.(sg) (Capt.)	LCDR (Maj.)	CDR (Lt. Col.)	TOTAL
Below 50	10	17	23	16	3	0	69
50-99	0	0	7	4	1	0	12
100-149	0	0	6	5	1	0	12
150-199	0	0	2	8	0	0	10
Above 199	0	0	11	10	11	1	33
Total	10	17	49	43	16	1	136

Mean: 117.2

Range: 0-1200

B. Simulated Instrument Conditions

Hours Flown	AC	ENS. (2nd Lt.)	LT.(jg) (1st Lt.)	LT.(sg) (Capt.)	LCDR (Maj.)	CDR (Lt. Col.)	TOTAL
Below 50	5	6	8	4	0	0	23
50-99	5	2	7	5	1	0	20
100-149	0	8	11	8	4	0	31
150-199	0	3	6	9	1	0	19
Above 199	0	2	17	19	10	1	49
Total	10	21	49	45	16	1	142

Mean: 160.6

Range: 25-700

TABLE XXI

HOURS OF USE OF THE REGULAR BLUE-AMBER SYSTEM,
ACCORDING TO STATUS AT TIME OF USE.

Status at Time of Use	Hours of Use: Below 50	50-149	150-249	250-499	500 and Above	Total
Student Pilot Only	21	2	0	0	0	23
Flight Instructor Only	0	0	0	0	3	3
Pilot Only	15	3	0	0	0	18
Check-Pilot Only	1	0	0	0	0	1
Student and/or Pilot and Instructor and/or Check-Pilot	11	34	9	9	7	70
Student and Pilot	7	4	0	0	0	11
Instructor and Check-Pilot	1	0	0	0	1	2
Total:	56	43	9	9	11	128

1 Flight instructor lists no hours.
1 Pilot lists no hours.
1 Student or Pilot and Instructor or Check-Pilot lists no hours.

TABLE XXII

HOURS OF USE AND FREQUENCY OF USE IN DIFFERENT AIRCRAFT OF THE BEAK-TYPE BLUE-AMBER SYSTEM, ACCORDING TO STATUS AT TIME OF USE

	Hours of Use						
Status at Time of Use	Less than 10	10-25	Over 25	TOTAL	Tandem or Single Place	Side-by-Side	Both
Student Pilot Only	1	1	0	2	0	2	0
Flight Instructor Only	1	0	0	1	0	1	0
Pilot Only	5	8	1	14	11	2	1
Check-Pilot Only	0	0	0	0	0	0	0
Student or Pilot and Instructor or Check-Pilot	2	3	1	6	4	1	1
Student and Pilot	1	3	0	4	4	0	0
Instructor and Check-Pilot	0	1	0	1	0	1	0
Total:	10	16	2	28	19	7	2

TABLE XXIII

FREQUENCY OF SIMULATED BLIND FLIGHT EXPERIENCE WITH THREE COMMON TYPES OF GOGGLES, BY HOURS OF USE

Types of Goggles	Hours Goggles Were Used: Less than 10	10-50	More than 50	Not Specified	Total
Brow-rest	9	29	28	1	67
Snug type	14	45	42	2	103
Visor	25	23	11	2	61
Total:	48	97	81	5	231

TABLE XXIV

MEAN, NUMBER OF RESPONDENTS, AND
STANDARD DEVIATIONS OF EVALUATION
SCORES FOR VARIOUS SYSTEMS

A.

A. Regular Blue-Amber

	Mean	N	SD
Safety	2.44	127	1.040
Comfort	2.46	127	.941
Proficiency	2.79	125	.883
Time Lost	2.07	124	1.135
Accomplishing Purpose	2.99	126	.776
Overall	2.55	118	.861

B. Beak-Type Blue-Amber

	Mean	N	SD
Safety	2.86	22	1.188
Comfort	1.86	22	1.295
Proficiency	2.52	21	.863
Time Lost	3.05	21	1.168
Accomplishing Purpose	2.52	21	.917
Overall	2.38	20	1.224

C. Venetian Blind

	Mean	N	SD
Safety	2.54	24	1.193
Comfort	3.46	24	.858
Proficiency	2.90	24	.899
Time Lost	2.76	23	1.012
Accomplishing Purpose	2.89	23	1.182
Overall	2.61	22	1.116

Table XXIV continued

D. SNJ Hood

	Mean	N	SD
Safety	2.88	119	1.093
Comfort	2.64	118	1.185
Proficiency	2.94	119	.848
Time Lost	3.11	116	.905
Accomplishing Purpose	3.05	117	.820
Overall	2.86	111	.918

E. Single-Engine Hood

	Mean	N	SD
Safety	.67	6	.742
Comfort	1.17	6	1.064
Proficiency	1.67	6	1.100
Time Lost	1.67	6	1.100
Accomplishing Purpose	2.50	6	.500
Overall	1.33	6	.571

F. Multi-Engine Hood

	Mean	N	SD
Safety	1.22	36	.949
Comfort	2.86	36	1.112
Proficiency	2.72	36	.995
Time Lost	2.37	35	1.101
Accomplishing Purpose	2.79	36	.882
Overall	2.13	32	1.005

Table XXIV continued

G. Window Blind

	Mean	N	SD
Safety	1.50	14	1.239
Comfort	3.29	14	1.267
Proficiency	2.93	14	1.096
Time Lost	2.57	14	1.240
Accomplishing Purpose	3.00	14	1.000
Overall	2.33	12	1.035

H. Red-Green

	Mean	N	SD
Safety	1.71	7	.889
Comfort	2.29	7	1.152
Proficiency	2.29	7	.430
Time Lost	2.29	7	.686
Accomplishing Purpose	2.43	7	.488
Overall	1.75	6	.682

I. Cardboard Beak

	Mean	N	SD
Safety	3.50	6	.500
Comfort	2.83	6	.908
Proficiency	2.70	5	.400
Time Lost	3.50	6	.764
Accomplishing Purpose	2.83	6	.397
Overall	2.83	6	.397

TABLE XXV

COMPARATIVE EVALUATIONS OF REGULAR
BLUE-AMBER WITH EACH OF EIGHT OTHER SYSTEMS

A. REGULAR BLUE-AMBER VS. BEAK-TYPE BLUE-AMBER

	Safety	Comfort	Profi-ciency	Time Lost	Accomp-lishing Purpose	Overall
Mean RBA	2.05	2.55	2.81	1.81	2.81	2.32
Mean BBA	2.86	1.86	2.52	3.05	2.52	2.29
Mean Diff.	-0.81	0.69	0.29	-1.24	0.29	0.03
No. of Cases	22	22	21	21	21	19
SE of Diff.	.410	.344	.230	.389	.250	.395
Crit. Ratio	-1.98*	2.01*	1.26	-3.19**	1.16	0.08

B. REGULAR BLUE-AMBER VS. VENETIAN BLIND

	Safety	Comfort	Profi-ciency	Time Lost	Accomp-lishing Purpose	Overall
Mean RBA	2.20	2.26	2.66	2.18	2.93	2.30
Mean VB	2.52	3.43	2.93	2.75	2.84	2.61
Mean Diff.	-0.32	-1.17	-0.27	-0.57	0.09	-0.31
No. of Cases	23	23	22	22	22	22
SE of Diff.	.355	.365	.330	.279	.308	.381
Crit. Ratio	-0.90	-3.21**	-0.82	-2.04*	0.29	-0.81

C. REGULAR BLUE-AMBER VS. SNJ HOOD

	Safety	Comfort	Profi-ciency	Time Lost	Accomp-lishing Purpose	Overall
Mean RBA	2.47	2.51	2.89	2.04	3.06	2.60
Mean SNJ	2.84	2.63	2.93	3.09	3.03	2.83
Mean Diff.	-0.37	-0.12	-0.04	-1.05	0.03	-0.23
No. of Cases	108	107	106	105	106	100
SE of Diff.	.143	.134	.112	.136	.094	.118
Crit. Ratio	-2.59**	-0.90	-0.36	-7.72**	0.32	-1.95*

** Significant difference (2% level).
* Difference of doubtful significance (10% level).

Table XXV continued

D. REGULAR BLUE-AMBER VS. SINGLE-ENGINE HOOD

	Safety	Comfort	Profi-ciency	Time Lost	Accomp-lishing Purpose	Overall
Mean RBA	3.00	3.00	2.80	2.60	3.60	3.20
Mean HSE	0.80	1.00	1.40	1.40	2.40	1.40
Mean Diff.	2.20	2.00	1.40	1.20	1.20	1.80
No. of Cases	5	5	5	5	5	5
SE of Diff.	.490	.707	.510	.860	.200	.583
Crit. Ratio	4.49*	2.83*	2.75*	1.40	6.00**	3.09*

E. REGULAR BLUE-AMBER VS. MULTI-ENGINE HOOD

	Safety	Comfort	Profi-ciency	Time Lost	Accomp-lishing Purpose	Overall
Mean RBA	2.68	2.19	2.55	2.27	2.94	2.46
Mean HME	1.19	2.81	2.71	2.30	2.74	2.00
Mean Diff.	1.49	-0.62	-0.16	-0.03	0.20	0.46
No. of Cases	31	31	31	30	31	28
SE of Diff.	.257	.280	.237	.269	.224	.229
Crit. Ratio	5.80**	-2.21*	-0.68	-0.11	0.89	2.01*

F. REGULAR BLUE-AMBER VS. WINDOW BLIND

	Safety	Comfort	Profi-ciency	Time Lost	Accomp-lishing Purpose	Overall
Mean RBA	2.60	2.40	2.89	2.70	2.90	2.50
Mean WB	1.30	3.10	3.00	2.80	3.00	2.25
Mean Diff.	1.30	-0.70	-0.11	-0.10	-0.10	0.25
No. of Cases	10	10	9	10	10	8
SE of Diff.	.496	.616	.564	.314	.458	.481
Crit. Ratio	2.62*	-1.14	-0.20	-0.32	-0.22	0.52

** Significant difference (2% level).
* Difference of doubtful significance (10% level).

Table XXV continued

G. REGULAR BLUE-AMBER VS. RED-GREEN

	Safety	Comfort	Proficiency	Time Lost	Accomplishing Purpose	Overall
Mean RBA	3.00	2.43	2.86	2.57	3.29	2.67
Mean RG	1.71	2.29	2.29	2.29	2.43	1.75
Mean Diff.	1.29	0.14	0.57	0.29	0.86	0.92
No. of Cases	7	7	7	7	7	6
SE of Diff.	.357	.144	.298	.183	.339	.415
Crit. Ratio	3.61**	0.97	1.91	1.58	2.54*	2.22*

H. REGULAR BLUE-AMBER VS. CARDBOARD BEAK

	Safety	Comfort	Proficiency	Time Lost	Accomplishing Purpose	Overall
Mean RBA	1.91	2.33	2.60	1.00	2.67	2.00
Mean CB	3.50	2.83	2.70	3.50	2.83	2.80
Mean Diff.	-1.58	-0.50	-0.10	-2.50	-0.17	-0.80
No. of Cases	6	6	5	6	6	5
SE of Diff.	.275	.563	.640	.619	.307	.255
Crit. Ratio	-5.75**	-0.89	-0.16	-4.04**	-0.55	3.14*

** Significant difference (2% level).
* Difference of doubtful significance (10% level).

TABLE XXVI

EVALUATION SCORES OF REGULAR AND BEAK-TYPE BLUE-AMBER ACCORDING TO LOCATION IN WHICH USED (BELOW 32°N ONLY VS. ALL OTHERS) FOR SIX CRITERIA/

Criteria	A. Regular Blue-Amber			B. Beak-Type Blue-Amber		
	Below 32°N Only		All Others#	Below 32°N Only		All Others#
Safety						
Mean	2.65		2.28	2.00		3.19
No. of cases	51		74	6		16
S.D.	.958		1.077	1.000		1.066
Difference		.37			-1.19	
Critical Ratio		1.96*			-2.26*	
Comfort						
Mean	2.37		2.50	1.00		2.19
No. of cases	51		74	6		16
S.D.	.913		.934	1.000		1.231
Difference		-.13			-1.19	
Critical Ratio		-.77			-1.92*	
Proficiency						
Mean	2.59		2.91	2.20		2.63
No. of cases	49		74	5		16
S.D.	.907		.838	1.166		.677
Difference		-.32			-.43	
Critical Ratio		-1.99*			-.97	
Time Lost						
Mean	2.10		2.07	1.60		3.50
No. of cases	51		71	5		16
S.D.	1.142		1.015	1.110		.707
Difference		.03			-1.90	
Critical Ratio		.13			-4.15**	
Accomplishing Purpose						
Mean	2.98		2.99	2.00		2.69
No. of cases	51		73	5		16
S.D.	.806		.781	1.095		.759
Difference		-.01			-.69	
Critical Ratio		-.07			-1.50	
Overall						
Mean	2.49		2.57	1.60		2.63
No. of cases	47		69	5		15
S.D.	.766		.948	1.356		1.080
Difference		-.08			-1.03	
Critical Ratio		-.48			-2.02*	

/ Positive differences indicate higher evaluations by the first-named group.
"All Others" include some respondents who used the systems in locations below 32°N in addition to locations above 32°N.
* Difference of doubtful significance.
** Significant difference.

TABLE XXVII

MEANS AND STANDARD DEVIATIONS OF EVALUATION SCORES FOR REGULAR AND BEAK-TYPE BLUE-AMBER ACCORDING TO PLANE TYPE

Criterion	A. Regular Blue-Amber			B. Beak-Type Blue-Amber		
	Single-seat or Tandem	Side-by Side	Both	Single-seat or Tandem	Side-by Side	Both
Safety						
Mean	1.95	2.54	2.76	3.13	1.80	4.00
No. of cases	29	80	17	16	5	1
S.D.	1.114	1.019	.748	.750	1.510	—
Comfort						
Mean	2.72	2.32	2.82	2.13	.80	3.00
No. of cases	29	79	17	16	5	1
S.D.	.706	.926	.933	1.157	1.166	—
Proficiency						
Mean	2.91	2.63	3.35	2.81	1.50	2.00
No. of cases	28	79	17	16	4	1
S.D.	.805	.906	.498	.645	.866	—
Time Lost						
Mean	1.93	2.03	2.53	3.38	1.75	3.00
No. of cases	29	79	15	16	4	1
S.D.	1.286	1.241	.966	.837	1.479	—
Accomplishing Purpose						
Mean	2.86	2.93	3.47	2.81	1.25	3.00
No. of cases	29	79	17	16	4	1
S.D.	.738	.819	.503	.645	.829	—
Overall						
Mean	2.44	2.45	3.12	2.89	.80	3.00
No. of cases	27	73	17	14	5	1
S.D.	.801	.892	.570	.816	.980	—

TABLE XXVIII

MEAN EVALUATION SCORES AND NUMBERS OF RESPONDENTS FOR VARIOUS SYSTEMS ACCORDING TO STATUS OF RESPONDENTS AT TIME OF USE

1=Student pilot only 2=Instructor only 3=Pilot only 4=Check pilot only	5=Student and/or Pilot and Instructor and/or Check-pilot 6=Student and Pilot 7=Instructor and Check-pilot

A. Regular Blue-Amber

		Status						
		1	2	3	4	5	6	7
Safety	Mean	3.00	1.75	1.97	—	2.46	2.20	2.00
	N	22	4	18	—	69	11	2
Comfort	Mean	2.41	2.50	2.56	—	2.43	2.70	1.50
	N	22	4	18	—	69	11	2
Proficiency	Mean	2.65	2.75	2.94	—	2.78	2.80	2.50
	N	20	4	18	—	69	11	2
Time Lost	Mean	2.32	2.00	1.82	—	2.10	1.70	1.50
	N	22	4	17	—	67	11	2
Accomp. Purpose	Mean	3.00	2.75	3.00	—	3.02	2.80	2.50
	N	22	4	18	—	68	11	2
Overall	Mean	2.59	2.50	2.36	—	2.59	2.44	2.50
	N	22	4	18	—	61	10	2

Table XXVIII continued

B. Beak-Type Blue-Amber

		Status						
		1	2	3	4	5	6	7
Safety	Mean	3.00	0.00	3.08	--	3.67	2.33	2.00
	N	1	1	13	--	3	3	1
Comfort	Mean	0.00	0.00	2.23	--	2.00	1.67	1.00
	N	1	1	13	--	3	3	1
Proficiency	Mean	--	0.00	1.85	--	3.00	2.77	2.00
	N	--	1	13	--	3	3	1
Time Lost	Mean	--	0.00	3.54	--	3.33	2.33	1.00
	N	--	1	13	--	3	3	1
Accomp. Purpose	Mean	--	0.00	2.62	--	3.00	2.77	2.00
	N	--	1	13	--	3	3	1
Overall	Mean	0.00	0.00	2.59	--	3.00	2.67	2.00
	N	1	1	11	--	3	3	1

C. Venetian Blind

		Status						
		1	2	3	4	5	6	7
Safety	Mean	1.25	2.00	3.60	3.00	1.88	4.00	2.50
	N	3	1	5	1	8	2	2
Comfort	Mean	2.67	3.00	3.60	3.00	3.63	4.00	4.00
	N	3	1	5	1	8	2	2
Proficiency	Mean	2.00	2.00	3.00	2.00	3.31	4.00	3.50
	N	3	1	5	1	8	2	2
Time Lost	Mean	1.67	1.00	3.20	3.00	2.79	4.00	2.50
	N	3	1	5	1	7	2	2
Accomp. Purpose	Mean	1.67	2.00	3.50	2.00	3.44	4.00	3.00
	N	3	1	4	1	8	2	2
Overall	Mean	1.50	2.00	3.20	2.00	2.81	4.00	2.00
	N	2	1	5	1	8	2	1

Table XXVIII continued

D. SNJ Hood

		Status						
		1	2	3	4	5	6	7
Safety	Mean	2.74	3.00	3.17	--	2.98	3.06	4.00
	N	69	2	6	--	24	16	2
Comfort	Mean	2.49	4.00	3.20	--	2.54	2.94	4.00
	N	69	2	5	--	24	16	2
Proficiency	Mean	2.84	3.00	3.33	--	2.88	3.19	4.00
	N	69	2	6	--	24	16	2
Time Lost	Mean	3.07	3.50	3.67	--	3.04	3.14	3.00
	N	68	2	6	--	24	14	2
Accomp. Purpose	Mean	3.09	3.50	3.33	--	2.67	3.20	4.00
	N	68	2	6	--	24	15	2
Overall	Mean	1.86	3.50	3.17	--	2.61	3.16	3.50
	N	63	2	6	--	22	16	2

E. Single-Engine Hood

		Status						
		1	2	3	4	5	6	7
Safety	Mean	--	--	.50	--	.75	--	--
	N	--	--	2	--	4	--	--
Comfort	Mean	--	--	1.50	--	1.00	--	--
	N	--	--	2	--	4	--	--
Proficiency	Mean	--	--	2.00	--	1.50	--	--
	N	--	--	2	--	4	--	--
Time Lost	Mean	--	--	2.50	--	1.25	--	--
	N	--	--	2	--	4	--	--
Accomp. Purpose	Mean	--	--	2.50	--	2.50	--	--
	N	--	--	2	--	4	--	--
Overall	Mean	--	--	1.00	--	1.50	--	--
	N	--	--	2	--	4	--	--

Table XXVIII continued

F. Multi-Engine Hood

		Status						
		1	2	3	4	5	6	7
Safety	Mean	1.27	1.67	3.00	—	.93	—	1.50
	N	11	3	6	—	14	—	2
Comfort	Mean	2.64	3.00	2.33	—	3.21	—	3.00
	N	11	3	6	—	14	—	2
Proficiency	Mean	2.46	2.33	3.00	—	2.93	—	2.50
	N	11	3	6	—	14	—	2
Time Lost	Mean	2.18	3.00	2.17	—	2.46	—	2.50
	N	11	3	6	—	13	—	2
Accomp. Purpose	Mean	2.45	2.33	3.17	—	2.97	—	3.00
	N	11	3	6	—	14	—	2
Overall	Mean	1.95	2.33	1.92	—	2.36	—	2.00
	N	10	3	6	—	11	—	2

G. Window Blind

		Status						
		1	2	3	4	5	6	7
Safety	Mean	1.29	—	2.00	—	2.50	—	2.00
	N	7	—	2	—	2	—	1
Comfort	Mean	2.86	—	3.00	—	4.00	—	4.00
	N	7	—	2	—	2	—	1
Proficiency	Mean	2.57	—	3.00	—	3.00	—	4.00
	N	7	—	2	—	2	—	1
Time Lost	Mean	2.29	—	3.50	—	3.50	—	3.00
	N	7	—	2	—	2	—	1
Accomp. Purpose	Mean	2.86	—	3.00	—	3.00	—	3.00
	N	7	—	2	—	2	—	1
Overall	Mean	2.17	—	2.50	—	3.00	—	3.00
	N	6	—	2	—	1	—	1

Table XXVIII continued

H. Red-Green

		Status						
		1	2	3	4	5	6	7
Safety	Mean	--	1.00	1.50	--	2.00	3.00	--
	N	--	1	4	--	1	1	--
Comfort	Mean	--	4.00	2.25	--	3.00	0.00	--
	N	--	1	4	--	1	1	--
Proficiency	Mean	--	2.00	2.25	--	3.00	2.00	--
	N	--	1	4	--	1	1	--
Time Lost	Mean	--	2.00	2.50	--	3.00	1.00	--
	N	--	1	4	--	1	1	--
Accomp. Purpose	Mean	--	3.00	2.00	--	3.00	3.00	--
	N	--	1	4	--	1	1	--
Overall	Mean	--	1.50	1.67	--	3.00	1.00	--
	N	--	1	3	--	1	1	--

I. Cardboard Beak

		Status						
		1	2	3	4	5	6	7
Safety	Mean	--	--	3.60	--	3.00	--	--
	N	--	--	5	--	1	--	--
Comfort	Mean	--	--	3.20	--	1.00	--	--
	N	--	--	5	--	1	--	--
Proficiency	Mean	--	--	2.88	--	2.00	--	--
	N	--	--	4	--	1	--	--
Time Lost	Mean	--	--	3.80	--	2.00	--	--
	N	--	--	5	--	1	--	--
Accomp. Purpose	Mean	--	--	3.00	--	2.00	--	--
	N	--	--	5	--	1	--	--
Overall	Mean	--	--	3.00	--	2.00	--	--
	N	--	--	5	--	1	--	--

Table XXVIII continued

J. Compartment in NH-1

		Status						
		1	2	3	4	5	6	7
Safety	Mean	3.00	--	--	--	2.50	--	--
	N	1	--	--	--	2	--	--
Comfort	Mean	1.00	--	--	--	2.50	--	--
	N	1	--	--	--	2	--	--
Proficiency	Mean	3.00	--	--	--	2.00	--	--
	N	1	--	--	--	2	--	--
Time Lost	Mean	3.00	--	--	--	2.50	--	--
	N	1	--	--	--	2	--	--
Accomp. Purpose	Mean	2.00	--	--	--	1.00	--	--
	N	1	--	--	--	2	--	--
Overall	Mean	2.00	--	--	--	2.00	--	--
	N	1	--	--	--	2	--	--

TABLE XXIX

EVALUATION SCORES OF VARIOUS SYSTEMS
BY RESPONDENTS WHO HAD USED THE SYSTEM AS
BOTH PILOT AND SAFETY PILOT

Safety

	Mean	N	SD	Rank
RBA	2.46	69	1.005	3
BBA	3.67	3	.445	1
VB	1.88	8	1.044	4
SNJ	2.90	24	1.063	2
HME	.93	14	.797	5

Comfort

	Mean	N	SD	Rank
RBA	2.43	69	.967	4
BBA	2.00	3	.817	5
VB	3.63	8	.445	1
SNJ	2.54	24	1.293	3
HME	3.21	14	.694	2

Proficiency

	Mean	N	SD	Rank
RBA	2.78	69	.801	5
BBA	3.00	3	.817	2
VB	3.31	8	.570	1
SNJ	2.88	24	.815	4
HME	2.93	14	.879	3

Time Lost

	Mean	N	SD	Rank
RBA	2.10	67	1.1[illegible]	5
BBA	3.33	3	.955	1
VB	2.79	7	.733	3
SNJ	3.04	24	.983	2
HME	2.46	13	1.220	4

Accomplishing Purpose

	Mean	N	SD	Rank
RBA	3.02	68	.607	2
BBA	3.00	3	.817	3
VB	3.44	8	.568	1
SNJ	2.67	24	.933	5
HME	2.97	14	.641	4

Overall

	Mean	N	SD	Rank
RBA	2.59	61	.803	4
BBA	3.00	3	.817	1
VB	2.81	8	.621	2
SNJ	2.61	22	.939	3
HME	2.36	11	.656	5

TABLE XXX

MEANS, NUMBERS OF RESPONDENTS AND STANDARD DEVIATIONS OF FREQUENCY OF OCCURRENCE SCORES FOR ALL SUGGESTED DIFFICULTIES WITH THE BLUE-AMBER SYSTEM

A. Blue Goggles

	Goggle A			Goggle B			Goggle F		
Difficulty	Mean	N	SD	Mean	N	SD	Mean	N	SD
1	.56	57	.741	1.53	89	1.110	.81	42	1.074
2	1.28	57	.914	1.49	86	.934	1.51	41	.918
3	1.29	56	.904	1.40	84	.895	1.38	39	.930
4	.23	52	.576	.25	79	.540	.29	35	.656
5	.53	55	.848	.43	79	.724	.61	41	.934
6	1.00	58	.947	1.37	83	1.060	1.31	42	1.439
7	1.07	57	.915	1.18	84	1.024	1.40	42	1.098
8	.72	68	.704	.90	72	.805	.95	39	.781
9	.59	64	.747	1.01	74	.969	.88	40	.948
10	1.18	68	1.024	1.60	75	.673	1.56	41	1.039
11	.95	66	.996	1.61	75	1.011	1.26	35	1.101
12	.77	65	1.029	.79	75	.911	1.14	37	1.114
13	.25	61	.668	.37	63	.780	.36	33	.811

B. Amber Panels

Difficulty	Mean	N	SD
1	.29	118	.590
2	1.35	119	.880
3	1.72	121	.909
4	1.26	121	.904
5	1.35	120	.952
6	.41	[illegible]	.693
7	.71	[illegible]	1.021
8	1.39	121	.946
9	1.52	122	1.113
10	.89	114	.831
11	1.87	116	.930
12	.27	106	.526
13	.15	103	.426

C. Beak Type

Difficulty	Mean	N	SD
1	2.00	28	1.069
2	1.33	27	1.093
3	1.54	28	1.317
4	1.27	26	1.226

D. General

Difficulty	Mean	N	SD
1	1.02	101	.933
2	.78	108	.992
3	.70	105	1.007
4	.53	106	.870

TABLE XXXI

MEANS, NUMBER OF RESPONDENTS AND STANDARD DEVIATIONS OF SERIOUSNESS OF CONSEQUENCES SCORES FOR ALL SUGGESTED DIFFICULTIES WITH THE BLUE-AMBER SYSTEM

A. Blue Goggles

	Goggle A			Goggle B			Goggle F		
Difficulty	Mean	N	SD	Mean	N	SD	Mean	N	SD
1	.67	23	.632	1.31	67	.658	1.08	18	.833
2	.59	44	.616	.62	71	.590	.67	30	.696
3	.50	44	.657	.54	71	.620	.78	32	.626
4	.22	9	.417	.53	15	.565	.25	8	.433
5	.78	18	.709	.88	24	.674	.87	15	.802
6	.97	35	.738	.98	58	.660	1.07	30	.619
7	.97	39	.704	1.12	52	.568	1.19	27	.660
8	.73	40	.665	.74	47	.623	.69	26	.799
9	.83	29	.644	1.02	46	.645	.80	20	.678
10	.98	45	.663	.94	52	.721	.97	30	.653
11	.89	35	.639	1.04	62	.689	.98	24	.720
12	.79	[illegible]	.740	.89	38	.560	.95	21	.725
13	.56	9	.681	.58	12	.643	.67	6	.742

B. Amber Panels

Difficulty	Mean	N	SD
1	.93	27	.593
2	.83	80	.659
3	1.00	99	.752
4	.70	86	.681
5	.91	83	.740
6	.85	31	.571
7	.53	34	.605
8	.56	91	.633
9	.69	85	.703
10	.68	65	.632
11	1.40	96	.632
12	.52	21	.590
13	.44	9	.501

C. Beak-Type

Difficulty	Mean	N	SD
1	.92	24	.697
2	1.67	15	.459
3	1.22	18	.789
4	1.11	18	.739

D. General

Difficulty	Mean	N	SD
1	1.06	62	.630
2	.78	46	.626
3	.62	37	.673
4	.91	34	.783

TABLE XXXII

MEANS AND MEAN DIFFERENCES IN FREQUENCY
AND SERIOUSNESS RESPONSE SCORES OF CORPUS
CHRISTI AND NORFOLK RESPONDENTS FOR THE
FOUR SUGGESTED DIFFICULTIES WITH
BEAK-TYPE BLUE-AMBER

Difficulty	Question	Corpus Christi Mean	Corpus Christi N	Norfolk Mean	Norfolk N	Mean Diff.
1	Frequency	2.27	15	1.69	13	.58
	Seriousness	1.23	13	.55	11	.68**
	Seriousness#	1.14	14	.46	13	.68**
2	Frequency	1.78	14	.85	13	.93*
	Seriousness	1.80	10	1.40	5	.40
	Seriousness#	1.38	13	.54	13	.84**
3	Frequency	2.20	15	.77	13	1.43**
	Seriousness	1.42	12	.83	6	.59
	Seriousness#	1.21	14	.38	13	.83**
4	Frequency	1.69	13	.85	13	.84*
	Seriousness	1.67	9	.56	9	1.11**
	Seriousness#	1.25	12	.38	13	.87**

** Significant difference (2% level).

* Difference of doubtful significance (10% level).

When respondents answering "Almost Never" to the first question are not excluded.

APPENDIX D

COMMENTS BY PILOTS CONCERNING VARIOUS ASPECTS OF SIMULATED BLIND FLYING EQUIPMENT

The Nature of the Comments

The sampling of comments on the following pages is organized under several headings:

It should be noted that these headings, corresponding generally to pages or sets of pages in the questionnaire, are for convenience only. Respondents were urged to comment freely on any aspect of simulated blind flying equipment, regardless of specific questions or directions. Many of them did so. Thus, many comments were not precisely on the subject at hand.

In order to present these comments substantially as received, a minimum of editing has been attempted. Chiefly, this consisted of changing nomenclature employed by respondents so that it is fairly consistent with that used throughout this report.

INCIDENTS ILLUSTRATING EXPERIENCES
WITH EQUIPMENT

1. Beak: In warm weather, TBM, fly with canopy partially open or discomfort from heat is great. Beak catches air from crack and continually is being thrown off.

2. The only thing I know of to advance the Blue-Amber system (with welder's mask) over other systems is that after a let-down has been completed the student can instantly "go contact" and make a simulated "low visibility approach" to the field. The hood takes too long to remove to allow this.

3. Black hood for single seat type - example F6F-3N, year 1945, Vero Beach, Florida. Experienced pilot was flying black hood with chase pilot; instrument plane in dive, gained excessive speed and panel of canopy became disengaged; rush of air caused black hood to encase pilot's head and approximately three minutes elapsed before he freed himself of hood. Luckily, he was at high altitude when casualty occurred.

4. Plane captains often "dope off" when canvas hood in PB4Y2 is being used, failing to keep a good lookout and endangering everyone aboard.

5. Everytime I finished using Blue-Amber system I had a headache and noticed considerable eye strain. I think the headache was mainly due to the supporting features of the visor and the eye strain was largely because of poor sight through the blue acetate.

6. If a pilot really wants to benefit from an instrument hop, he can do as well without the goggles but with amber up. On hazy days, I have flown over an hour with amber on and no goggles and have not once seen a landmark or had reference to a visual horizon. This method best simulates actual instrument. However, it won't work if the pilot deliberately looks outside. Using only the amber the cockpit vision is clearer. I find it harder to read my instruments with goggles on than I do at night or actual IFR conditions. Recommend a side attachment around the goggles to prevent light entering the side.

7. As a student going through instrument training I found that with the Blue-Amber (visor type) system I was much more comfortable and at ease under actual instrument flight as compared to the times when wearing the visor under simulated instrument flight. The visor always seemed to give me a closed-in feeling.

8. The beak type is difficult to handle in single-engine plane which generally does not have a convenient place to store it while not in use.

9. Engine Failure - F4V-4 type aircraft. On instruments (goggles and beak in use). Equipment became hopelessly fouled on lip microphone with no time to waste in an attempt to throw it clear during emergency recovery procedure. Constituted a dangerous situation, unnecessary altitude loss, could have cost an aircraft as well as a pilot if altitude safety factors were not present.

INCIDENTS (continued)

10. I used Regular Blue-Amber in advanced training. I used the beak only four times. They are both good systems. My only reason for rating regular blue goggles above the beak is the beak got in my way a few times.

11. The amber hood installed was warped causing distortion, double vision and reflection making it unsafe for taxiing, landing or take-off.

12. In the F4U with Blue-Amber, the top hood was not covered with amber and although I don't know whether the sun came through that or the amber, but flying into the sun caused reflections on the instruments which made it almost impossible to read them. Also in this type of aircraft, I found that it was uncomfortable inside without the hood open.

13. I like the Blue-Amber best of any yet found, but prefer sun-glass type goggles better than others. Would like to see polarized windshields and goggles so that no time of installation nor maintenance would be lost. And in addition, more safe as no restricted visibility would be encountered.

14. Black hood in F6F drops down over pilot's head at low airspeed due to lack of ventilator air which holds it up. This situation is very dangerous and this type hood if still used should be discontinued in my opinion.

15. Using the Blue-Amber in the PB4Y-2 with amber window panels. I used the blue with head band (mask); everytime I looked up to radio gear the head set came off. Also head set did not fit good over the head band.

16. As an instructor in PBM aircraft on a simulated instruments instruction flight, I am continually looking out of the plane for other planes to prevent collision. We are using red panels instead of amber and it is hard to see through the red panels, especially on hazy days, visibility through the red panels is reduced to as low as 1/2 mile. This causes continual apprehension and I find it detracts from the attention I can give to the student. I have never used the beak type but if it does not cause undue discomfort to the wearer, that would seem to be the solution to my particular problem.

17. Most of my flying is done with Blue-Amber which I consider best of all systems I have seen at present time.

18. With the amber glass or any glass in the cockpit vision for the safety pilot is cut to 50%. As for accomplishing the purpose I believe blue and amber fine.

19. I feel that Blue-Amber is most satisfactory. Many twin-engine types give distortions when looking across cockpit, such as on turns to landing approaches and the amber enlarges this distortion. On flare out with nose high, drift recognition and altitude are especially hard to distinguish with the amber in place.

INCIDENTS (continued)

20. Blue-Amber: While making a landing into the sun, reflections blocked some instruments causing use of one hand to cut down reflections.

21. Student in NAAWFS in October, 1948 was flying radio hop. Trying to tune in radio receiver. Allowed plane to go into graveyard spiral because poor vision of receiver dials. Same student had trouble seeing controls on deck of plane.

22. Preference for blue eye cover over red is made from the point of view that under conditions of low visibility, training may be continued safely and with a fair degree of proficiency by removed windshield cover and using only goggles.

23. Once when student was making landing in SNB from left side (Instructor on right) and still had visor type goggle on head (visor up), rough landing caused visor to drop, completely cutting off vision to outside. Incident caused considerable anxiety on part of student and instructor alike. Now students either take off goggles altogether or amber hood is taken down during landings.

24. Blue-Amber: Amber seriously restricted visibility in TBM while making landing. At last moment, noticed plane on runway where I intended to land. Also very easy to lose sight of other planes in landing pattern ahead of you.

25. Near collision due to poor visibility on hazy days quite frequently during past two years.

26. With Blue-Amber system, under certain conditions of sunlight and with scratched or dirty amber window panels, the instructor pilot or check pilot does not have good visibility, resulting in rather close encounters with other aircraft in the air.

27. General usage of Blue-Amber gives best visibility to safety pilot except under hazy weather conditions. Recent flying as instructor in SNB's, has caused me eyestrain, discomfort due to inability to see well enough for safe flying.

28. When flying with Blue-Amber in single-place planes always keep good and frequent radio checks with chase plane. I never noticed it being any hotter in a cockpit because of the amber enclosure. The reason for this is knowing you are on simulated instrument tactics and you can go contact any time desired. The tension is off and you feel more relaxed

29. Amber flew out on TO in an AD-1 at Norfolk because amber was cracked. Never had very good visibility while chasing other planes who were on instruments. Hard to fly close enough formation to check instrument readings to see if other pilot is within tolerances. All this because of amber.

30. In general it has been my experience that the amber was not easy to remove in flight; consequently, flying around in a traffic pattern with other aircraft on a hazy day is dangerous.

INCIDENTS (continued)

31. Think Blue-Amber is good as my own personal instrument efficiency (simulated and actual) has improved greatly, and as an instructor, have watched the proficiency of students improve. Have removed hood from simulated when entering actual weather and have noted no change in flying ability.

32. With amber glass and brow-rest, smoke in cockpit reduced visibility causing very poor results.

33. Full opaque hood. Durable, sensible, can be fabricated in field areas, don't have to depend upon supplying activities, is actually the only true blind system. Comfortable, inexpensive.

34. My biggest reaction to Blue-Amber was physical discomfort - headaches. The hood system allows more freedom of movement and better visibility of instruments, throttles etc. With multi-engine aircraft where personnel are available to be on the look on port side - with voice communication with safety pilot - safety factor is as good as with Blue-Amber. Proficiency and accomplishment of purpose are directly proportional to comfort of individual. Time lost is negligible.

35. On a return flight from San Antonio, I thought I would practice some instruments. The R4D I was flying was equipped with the amber windows and blue brow-rest goggles. The time of day was about 1700 and our course was 138° M which put the sun on our starboard quarter, causing the instrument panel to reflect the sun rays against the blue goggles. The reflection resulting made it impossible to see the instruments. We then covered the starboard window to cut down sun light and it was so dark I tried using the instrument lights, but they were not much help being the fluorescent type that make the instruments glow. All in all I did not like using this system.

36. This area is heavily congested with planes flying simulated instruments and the canvas blind blocks out the vision on half the plane. I have come dangerously close to other aircraft when the hood was up even though lookouts were posted on the blind side. Our hops are 4 hours long and a lookout can get careless for a few seconds only with dire consequences.

37. After having almost collided with another plane twice in a six month period while using the canvas hood, I changed to the amber glass/blue visor system. The situation was caused partly because of flying into early morning sun and partly due to laxness of the lookout in a top turret (PB4Y). I (the instructor) would have seem the other planes if amber glass had been on the windshield because to the canvas hood I didn't see them until we started to turn to port.

38. As an instructor I find that the blue goggles put undue strain on students' eyes, usually resulting in headaches and extreme fatigue when used for periods up to 2.5 hours. After first 1.5 hours, students' work begins to lag considerably because of fatigue and patience wearing out.

INCIDENTS (continued)

39. The blue goggles make the job of instrument instructing harder on the instructor and make the whole job of flying instruments harder on the student since he gets tired early in the period and frequently has headaches due to eyestrain.

40. Whenever direct sunlight strikes any type of goggle the person is blinded. Have had students lose complete control because of sun shining on goggles from starboard side (safety-pilot seat) on left turn.

41. Near collision using Blue-Amber. Safety pilot did not see approaching aircraft through the amber glass. Other plane averted collision. Pilot's judgment on landing with amber screen seems to be seriously impaired.

42. I am in a continual state of expectation when flying with the canvas hood in the PB4Y-2. I have had too many close calls with this blind spot to port.

43. In PBM type aircraft, port side of cockpit is enclosed with amber panels, leaving starboard side open and clear. At times, in the mornings or late evenings when the sun is low, sun glare on the blue goggles distracts the student to the extent of spoiling his problem. This only when sun shines through the starboard side.

44. Tried leaving side window slightly open on T.O. with Blue-Amber system on hot day for ventilation. Side panel was sucked out during run resulting in loss of panel. Must suffocate or have only partial hood and allow for "peeping".

45. In my opinion, that lack of vision is very detrimental. Last week I was making low approaches, on GCA, with a student using Blue-Amber at about 500 feet altitude, while passing over the field I saw a PB4Y2 on collision course. His port side was blind too.

46. I have not noticed any system that is actually good from all standpoints. If it were possible a system of clear glass of some material should be used in the cockpit so that with the naked eye a person can see out normally but would be totally black when some specified glasses or goggles are used.

47. Used a hood recently in a PB4Y-2 in the capacity of instructor. It was a very hazy day and although I had lookouts posted to the port side, I had several near collisions as the lookouts themselves were confused by near instrument conditions. Finally had the hood taken down, the student lower his seat and told him not to look out. This is very satisfactory anyway in multi-engine types.

48. Students take a beating on warm days completely closed in, windows closed, struggling with window panels, masking tape all over - panels fail to stay up, do not fit properly - cheating very possible, perspire readily, glasses fit loosely. If student is at ease completely under

the hood, does much better flying. Of all systems, Blue-Amber do believe could be made the least discomforting. Have manufacturer equip all ships with a system that could be lowered or raised (blue, amber) at ease.

49. I prefer the use of the visor over the goggles for two reasons:
1. The visor may be quickly and easily pushed up out of the way to allow for immediate contact flight whereas the goggles are a bit difficult to remove when held down by headphones.
2. I have had so many students who very noticeably strained to see the instruments through the blue glass, putting them in a non-relaxed position necessary for good instrument flight. The visor eliminates this because the student may lift the visor enough to see the instruments normally and still shut out light through the windshield.

50. While using the beak making an ILS approach, the long extension was constantly catching or bumping into some part of the cockpit, thereby causing caution to be exercised in looking around the cockpit and thus causing a lowering of the average instrument flying efficiency.

51. For multi-engine aircraft, a hood should never be used, for safety reasons. Considerable time is always lost in rigging a hood because of improper markings on hood to show where each corner fits and there are always a few snaps missing.

52. Blue-Amber: Scarred amber so seriously restricts vision that a real safety hazard is created. Several times I have not been able to see other traffic until dangerously close.

53. While instructing at Pensacola in SNJ's, students had a lot of trouble hooking up instrument hoods; this would tend to make them nervous. Hood would snap open during flight also. All this was very time consuming. This could be improved by all amber hoods and goggles.

54. To me, the prime consideration of flying is safety and up until 2 or 3 weeks ago I used the canvas hood provided in the PB4Y to cover the left hand side of the windshield and the left window. Then one morning the field was pretty hazy and visibility was not over two miles; twice during the morning we came dangerously close to other planes at a low altitude because the mechanic who was supposed to keep a sharp lookout on the left side had his attention elsewhere. I have the boys drop their seat down so they can't see forward and it's nothing but confusing to peek out the side. The amber shield is far better for safety purposes, but works a hardship on the man who has to look at the instruments through the blue goggles.

55. The canvas hood, which covers the left front and left side window only, placing pilot on instruments has following advantages: Pilot has no goggles to fog, fall off, slip down, get dirty, interfere with headphones, irritate the ears, bridge of nose, perspiration running down glass. Affords plenty of light but safety is poor - safety pilot can't observe out port side of aircraft, dependent upon crew in rear of aircraft.

INCIDENTS (continued)

56. Blue-Amber: An I.T.O. student climbed out with amber shield installed on his side with visor on - glare from shield prevented my seeing a plane descending to field from range station - near miss! Too much glare is given off at some angles to the sun.

57. We used this Cardboard Beak on GCA approaches down to 400 feet. When you want to go Contact - you can immediately and you have good vision forward and to the sides. An idea would be beak-type and visor mounted integrally, with the angles to instruments and edge of canopy figured to obscure horizon.

58. No specific instance. Have always disliked Blue-Amber system in fighters because of its time consumption and the inevitable cracking of the amber. In a type such as the F8F I believe only a beak, without any lens, would be the best system.

59. Safety pilot in multi-engine should have 360° vision if possible. This is impossible with canvas hood. Blue-Amber adds safety which is its strongest and only argument. With proper design, faults (inconvenience, etc.) should be eliminated.

60. The hood in the PB4Y-2 causes the instructor to rely on a crewman as lookout on the port side.

61. As an instructor flying approximately 80 hours a month behind amber window panels, I find that there is some eye strain due to the intensity of the light coming through the amber.

62. As an Instructor I have frequent headaches which I am convinced are the direct result of straining to see through the amber. Amber pieces do not always fit well, allowing light to penetrate into cockpit which causes reflections and in some cases vertigo. Also, a system that would not necessitate putting in and removing amber pieces would be helpful, because just amber alone causes eye strain (in my case particularly).

63. Although the hood is the best system I have found, it should be improved. This morning two planes were coming in over the high lane at the same altitude but from different directions. The outer plane was blocked out by the hood until the planes got too close. The "lookout" was not posted at the best position. Even though he had been posted at a better position, the pilot wants to be able to see out while giving the student as much comfort as he can.

64. Students must retune receivers - which with a visor and earphones on is nearly impossible when the controls are overhead. Usually the earphones fall off because of the visor - through which the student usually cannot see, in any direction.
In the curtain, visibility is restricted to the left - several near mid-air collisions have occurred at this station with the hood.

65. In late afternoon with a low sun it is possible to see through the Blue-Amber system.

INCIDENTS (continued)

66. The Blue-Amber system worked very well on hooded GCA flights flown in Norfolk area (4 hours) by me.
The pilot flew within 50 feet of the ground before raising the glasses - which is a simple maneuver - and contact flight was established.

67. Most pilots have a phobia of landing the plane with the amber installed; consequently it is removed haphazardly prior to landing and suffers abuse. A dirty or scratched amber is difficult to see through, that is to pick out other aircraft. Cheating is possible, and discomforts from the goggles together with the earphones is very annoying.

68. I was flying in the left seat of a JRB using Blue-Amber. Since I have an insecure feeling, knowing that the vision on port side of plane was poor I "cheated" through a small opening in the amber checking before I turned. There was a PBM headed straight for my plane. I believe that had I not seen this plane a collision would have occurred.
I thoroughly believe that safety is violated in all methods used to create blind flying. Two pilots observing for other planes is better than none. Probably if a three way control was set up simulated blind flying could be more safely performed.

69. Prior to using beaks in the SNB we had several near-accidents while using the amber hoods due to the fact that the check pilot's vision was seriously cut down by the amber hood. Visibility was particularly bad for the check pilot on hazy and smoky days.

70. I believe the Blue-Amber system is dangerous around an area of intensive training since visibility is somewhat restricted. More so in haze weather conditions.

71. In single-seat aircraft as the AD, Blue-Amber system is excellent and safe as long as radio contact is possible. As soon as contact is lost, a very dangerous situation arises and only by putting the instrument plane in prop wash can you get him off instruments. A very near mid-air collision between an AD and an SC-1 resulted from a radio failure recently because the instrument plane was taking a simulated throttle linkage failure and had full power on. The chase pilot was unable to contact or overtake him, and the SC pilot must have been reading a comic book. Neither plane altered course or altitude and missed less than a plane's length (at the same altitude) at the crossing. We returned to base as soon as he became contact - which was immediately.

72. I think the Blue-Amber system is the best so far, since it provides the best visibility for safety pilot.

73. On a local training hop under VFR conditions 3 miles smoke and haze at the airport does not mean 3 miles visibility in the entire area. Visibility is restricted due to smoke and further restricted due to the amber glass; it is a definite eyestrain on the safety pilot.

INCIDENTS (continued)

74. Blue-Amber system is highly recommended with the use of brow-rest glasses.

75. The amber on the windshield has very bad visibility in contact flying on cloudy days. I went into a spin due to a false horizon.

76. Our squadron does not like the Blue-Amber system because it offers the pilot good visibility only occasionally and it is a nuisance to handle the gear where movement is necessary.

77. I like the SNJ Hood because it has nothing on the pilot's head to discomfort him. He can't see out and the cockpit has the same vision he would normally have. The pilot in front seat has no amber glass to bother him and he has good vision.

78. Very recently I had a student on an instrument training hop, using the Blue-Amber system. The visibility was fair but hazy with a few large scattered clouds. Several planes in the area. I had a very hard time judging the distance we were from the other planes and also the clouds and, about the time the student would orientate himself on the range, I had to take over to avoid hitting another plane or flying into one of the big clouds and even with all my care, we were in several big clouds before I thought we would be. It could just as easily have been another plane. This system in my opinion is very dangerous and you don't realize what poor visibility you really have until you run into the same situation I have just described. Actually you think you can see well, but you have no depth perception at all.

79. While making GCA runs, an SNJ in landing approach (and apparently watching runway out left side of his cockpit) nearly crashed into me at 300 feet due to the fact that safety pilot (on right side of R4D cockpit) could not see through amber glass due to sun glare - and I naturally could not see out since I was wearing goggles (tower operators on a different radio frequently were telling the SNJ to take a wave off but he was not receiving the tower).

80. Majority of work with Blue-Amber and SNJ Hood - believe them efficient and practical for single-engine training.

81. While using the Blue-Amber system in an AD-1 approximately a month ago, I experienced trouble in judging distances horizontally and vertically. The trouble was due to the amber being bent badly and scratched. It is impossible to keep the amber from being damaged while installing it in the AD-1, but I would like to see a system devised which would stop this damage. If the amber and blue are both clear and not bend the system is excellent but this is seldom the case.

82. System not mentioned here used in Link trainer with frosted glass and the light machine reflecting and simulating light and heavy cloud cover comes the closest to real thing. With any of these other systems

you have very little distraction in the way of varying light. The natural tendency to go contact the moment a clear spot is reached or imagined it is reached fouls up person. Very seldom you will leave your instruments under the rest of these systems. As a result you don't get that foamy foggy look that does so much toward fouling a person up. I feel I do a much better job under the hood than I do under actual conditions because of the fog and apparent motion that you can't get away from even if you stay with instruments because of your side vision.

83. In a JRB, when the Blue-Amber system is used, if the amber sections do not cover the corresponding windshield sections completely and allow a strip of sunlight to enter cockpit, a dangerous situation arises in that this sunlight falling on the blue glasses temporarily blinds the pilot. Much time is lost afterwards acclimating the eyes to the dark cockpit.

84. Blue Goggle -Amber Panels: Goggles fogged - perspiration collected in bottom of goggles and had to be lifted from time to time. Blue Visor: Light reflected from under visor and head had to be placed in awkward position to see instruments through glare.

85. While flying simulated instruments in an F4U-4 I hit slip stream that almost turned me on my back. I had on the snug type goggles, making it very easy to reach up and pull them off. They are the most comfortable and easiest to use.

86. On a radio range cross-country hop I was on Beak-Type Blue-Amber system, when my chase pilot told me there was a plane at one o'clock. By just raising my head I was able to spot the plane without delay or movement of my hands from the controls. The type I like. While on a GCA hooded run with Regular Blue-Amber, I was making a hooded run and due to the lack of sunlight I had trouble seeing contact after the run was completed. Had to remove the panel before landing. This I dislike.

87. Reduced visibility in the Blue-Amber system causes me a great deal of anxiety in landing and taxiing. It has happened on every hop with this system.

88. Amber panels and blue goggles have been used in my squadron until recently. We are now trying the beaks. The amber panels were difficult to maintain in good condition. They were hard to install, and some hops were late getting out due to this. They did not fit securely. When taped, tape gummed the glass, and pulled off in slipstream. The pilot's vision was curtailed by the amber. The beaks are new to us. Their chief fault seems to be restricted instrument vision, and ease of "sneaking a look" outside the cockpit. They are also difficult to manipulate in single-engine planes.

89. Very hazy day with amber panels installed. Came into pattern to land with heavy traffic involved. The amber panels were very warped and visibility through them extremely poor. I left the traffic pattern and spent about 5-10 minutes removing the amber - then

returned to the pattern and landed. Since then I have used the Beak-Type Blue-Amber.

90. I would like to use panels of amber always with blue goggles, only I think there should be an easier way of installing the panels and they should be so fixed for the pilot to be able to remove them in flight. During the days of poor visibility the vision is very much impaired by the amber panels. The beak type should be made lighter and more comfortable. I don't believe a beak can be designed to afford vision of all instruments and no outside vision.

91. In order to get anything out of simulated instrument practice the pilot must be comfortable and able to see his instruments. That is essential.

92. Almost had head-on collision using Blue-Amber system due to dirty scratched amber glass.

SPECIAL FEATURES OF VARIOUS SYSTEMS

Regular Blue-Amber

1. Poor visibility in haze, through amber windshield; panels poorly attached (fell out frequently).

2. On hazy days over unknown areas, goggles were not used, and yellow panels alone simulated instrument conditions very well.

3. Pilot keeps cooler.

4. Any time visibility is so poor or lighting (natural) so weak that additional light is needed, I feel that to use the amber is to invite an accident.

5. Red color, indirect lighting, in F6F5N and F7F3N.

6. Light coming through the uncovered portions causes an awful lot of glare.

7. Okay except there could be a smaller shield or goggles for the eyes.

8. Cockpit in JRF darker than most other types I have flown and artificial light is desirable on dark days. Engine instruments on overhead.

9. Poor; very little light on the instruments. Cockpit light (fluorescent) did not improve matters.

10. Gives the safety-pilot or instructor full visibility. Blocks out vision outside but allows almost full vision on instruments.

11. Dislike any method of this sort.

12. Blue cuts cockpit visibility considerably. Amber at a young age cuts visibility down for check pilot outside of cockpit.

13. Allows good visibility but poor depth perception for safety pilot.

14. The system is too artificial.

15. It is very good.

16. Allows you to see other aircraft better than if a canvas hood is used.

17. We had trouble keeping amber attached to canopy especially landing and takeoff due to turbulence.

18. Snap-on amber sections(usually three sections).

19. Individual panels held in place with masking tape favored over framework - easier to remove if necessary.

20. On one flight, a built-in bright light was used. I found it very beneficial.

21. When flying into the sun, instrument panel was unable to be seen.

22. Bad feature - easily soiled and hard to clean after it is once installed.

23. On sunny days horizon and clouds can be seen. Goggles lower ability to read instruments easily and, except for brow-rest type, restrict vision in cockpit which tends to put pilot less at ease.

24. Dislike contact flying with amber panels - hinder visibility.

25. It can cause trouble on hazy days when flying contact with amber panels in. If the panels are wavy it can cause distortion and poor depth perception on landings.

26. Overhead was not covered and during daylight hours no artificial light was needed.

27. The light was special made for instrument training planes. It lit up the instruments but was shielded from your eyes. Different types all simple construction.

28. Difficulty was experienced in keeping the coverings rigid. Some were lost over the side when hatch was opened for landings. The amber windshield was deceptive on landings under conditions of haze and twilight.

<u>Beak-Type Blue-Amber</u>

1. Uncomfortable, restricts breathing, any G load obscured instruments. G-load in turns pulls beak down and covers all instruments.

2. I surely wouldn't want it to get loose in a cockpit.

3. Not worth using.

4. It was so unsatisfactory that I had the student remove it after 5 minutes. Kept falling off and bumping into things.

5. Comfortable providing all hinges and elastic properly installed.

6. Complete cone of amber glass or heavy paper.

SPECIAL FEATURES (continued)

7. Bulky.

8. I think regular blue goggles are better.

9. Easier to use, just as efficient and far more comfortable than the regular blue-amber system.

10. Haven't used beak but looks acceptable.

11. Excessively distracting.

12. Get rid of this system. It is N.G.

13. Have not used it much. Glass too far from eyes causing poor vision. The entire mask is hot.

14. Requires constant scanning. Cone type beak used is impractical.

15. It's hard enough for some pilots to fly instruments and it is definitely a handicap for him to have to worry about the beak, too.

16. The beak by itself is not enough. You are always somewhat conscious of the horizon.

17. If the beak is made right and installed right I believe it is much superior to the hood in that visibility is not disturbed during landings and takeoffs and also while flying simulated emergencies both goggles and beak can be removed quickly.

18. Believe beak system poor for CV aircraft since cockpit space is so limited.

19. Using this system in a twin-engine aircraft has led me to a favorable opinion. Safe in fact that you have instant vision by getting head back.

20. In a TBM, the seat must be completely lowered and the head still must always look down upon the instruments. Using the beak we can obtain use of our standby gyro horizon, while with the amber hood, it is blocked off.

21. I believe its over-all advantages far exceed any other type now in use. No installation worries, taken off for landing and take-off, combine instrument with other type hops etc.

22. Much care is required in single-engine aircraft to keep beak from carrying away in slipstream while handling it. It is inconvenient to substitute the beak and goggles for clear goggles, and vice versa, while flying.

23. Easy to clean and in case of emergency, (danger of collision) quick to go contact with maximum visibility.

SPECIAL FEATURES (continued)

24. This type allows the safety pilot good, full visibility.

25. Beak can be easily removed and stowed avoiding trouble with panels.

26. I do not like this system as well as the amber window panels, because it is not as comfortable to use. Our squadron lost two sets the first day we used them. The pilot is able to see out in front of him in steep turns which causes vertigo.

27. The beak is hard to shape correctly to give full view of instruments.

28. I do not like the beak. Would never use it if I could get amber panels.

29. In TBM's with seat life raft, pilot must fly with head bent forward to obtain instrument conditions, as pilot usually sits high in seat.

30. The beak is better than present windshield covering system.

Venetian Blind

1. Fell and locked yoke on T.O. Threw it into back of aircraft then, didn't use after.

2. Very good for student since he did not have to worry about goggles.

3. Blind used for two front windows, curtain for side. Very good system.

4. Venetian Blind over pilot's windshield too bulky and heavy to handle much. Made of lighter material, this would be the ideal system.

5. Allows instructor to see out to port but keeps student on instruments.

6. Blind on pilot's side only.

7. Sections of aluminum that would let the check pilot see out but not the check student.

8. Visibility is poor as eye travel is broken up. Very unhandy to install and remove.

9. Venetian Blind of vertical panels placed across front windows which could be adjusted for full vision for check pilot and complete shut out for pilot. Panels used for side windows which closed out the pilot and gave limited side vision for check pilot. Requires safety lookout to sides.

10. Instrument visibility good, outside visibility fair.

11. Since windows are not all covered pilot does not develop confidence in his instruments.

SPECIAL FEATURES (continued)

12. Use Venetian Blinds over pilot's windshield.

13. Vents in blind perpendicular to pilot, parallel to copilot's vision.

14. Venetian Blind placed upon front window.

15. Best I have used. You feel free to concentrate on instrument flying and the safety pilot has good visibility.

16. Covers only left front windshield, affords greatest visibility for safety pilot; is therefore safest system! is therefore the best system!

17. Venetian Blind, similar to that used in a house, giving vision to the check pilot and blanking out the area on the outside to the student. This system is good, because it leaves the student with unobstructed vision direct to the panel only, without glasses.

SNJ Hood

1. Flapping of canvas is very distracting; does not simulate instrument flight too well; too closed in.

2. Much too restricted - closed in feeling.

3. Easy to put up and down.

4. N.G. Too hot - feel cooped up.

5. Conducive to claustrophobia.

6. Easy to see by hood unless hatches are blacked out.

7. Flaps sometimes drop down in the way, and ITO with canopy open is very difficult because of flapping hood.

8. The hood sometimes interferes with your movements.

9. Very good except for the system of hooking flaps - suggest a quick release strap - as was they very often fell down obscuring side panel instruments.

10. Gives a very closed in feeling. Very warm and uncomfortable.

11. Hooded systems when applicable are the best, because of lack of eye strain, far better vision of instrument panel.

12. Lever in pilot's (instructor's) seat to pop hood open and shut to simulate broken-cloud work.

SPECIAL FEATURES (continued)

13. Bad.

14. Used only in rear cockpit.

15. O.K. for this type plane.

16. Hot and stuffy. Induces claustrophobia.

17. None. Very hard for student to erect; would frequently release during work.

18. Visibility of instruments unrestricted. Outside visibility for safety pilot poor!

19. Good. No goggles, no uncomfortable feeling, visibility not restricted through side vision. No fogging.

20. Hood would keep flying open - causing poor work.

21. As long as you are the back seat man and there is a pilot in front, it's safe.

22. Only fair because of closed-in feeling produced by hood.

23. Airways instrument flight should not be made in any single-engine, single pilot plane.

24. Consider the hood a very sloppy system.

25. Uncomfortable, warm.

26. "Cheating" is too easy. Large opening forward on left and right, unless painted.

27. Hood is hard to operate sometimes.

28. Enough light is let in from side of hood to read instruments.

29. Regular canvas hood that comes over from rear and snaps over panel.

30. You can rest assured the safety pilot has good visibility while you fly instruments.

31. Hood o.k. when safety pilot in same plane. Panels of canopy forward of rear cockpit should be painted.

32. Hood is fairly good, but could be better if improved to cut out spaces left open.

33. Ease of placing it in operation is good. Sometimes gives feeling of claustrophobia.

SPECIAL FEATURES (continued)

34. Incomplete coverage of contact visibility.

35. Not enough headroom and hard to close.

36. You lose time in putting hood up because of poor fastener.

Hoods

1. (PBY) Not safe for safety pilot.

2. (SNB, F6F) Light black hood in F6F held up by ventilation air.

3. (PBM) Very dangerous!

4. (PBY) Are not able to see all instruments and controls that are used. Tac. gauges, Hg. gauges, prop. and throttle quadrent. Too hot. Too blind for safety pilot.

5. (PBY, BP17) Quick installation but co-pilot cannot see safely.

6. (PB4Y2) Very satisfactory.

7. (SNB, PBY) Safety pilot cannot see out well enough. Also distracts student too much.

8. (PB4Y2) Good instrument visibility no headstraps - gadgets. No headaches.

9. (PB4Y2) Desirable in dual control type where it is possible to station lookout on portside.

10. (PB4Y2) Visibility nil on port side aircraft - hood made of wood and canvas.

11. (PBM-5) Very "closed in" feeling. Warm and uncomfortable.

12. (PB4Y2) Blinds the vision to port side, not safe.

13. (PB2Y3) Bad.

14. (R5D, PB4Y2) Dangerous to use in areas with heavy air traffic. No visibility to the left.

15. (PV2, PB4Y2) Prefer visor which can be lifted quickly and easily.

16. (PB4Y) Dangerous. Pilot's side is too blind.

17. (F6F) None. Would tend to collapse. Would cover some engine instruments used during flight.

SPECIAL FEATURES (continued)

18. (PB4Y2) Good. No goggles, no uncomfortable feeling, visibility not restricted through side vision. No fogging.

19. (PB4Y2) Hood on left side with student gives him complete and true picture of instruments with plenty of light coming in on right side.

20. (F8F-1) Hood was merely a sack attached to instrument panel and draped over head. Cloth often draped and obscured vision of top instruments.

21. (PB4Y2, PV, JRB) Curtain.

22. (F7F) Attached to gunsight and over pilot's head. Very poor - hood fit around top of instrument panel and was secured to gun charge handles. Was closed at end and fit behind pilot's head. It would sag and obstruct instruments.

23. (PB4Y2) Piece of canvas comes back horizontally from top of instrument panel, resting on pilot's head and fastening behind. Seat must be all the way down.

24. (PBY-5-5A, JRF-5) Left a blind side to plane. Check pilot could not see enough on hooded side.

25. (R4D) Takes too long to install.

Window Blind

1. Canvas is used to block off windows on pilot's side. Canvas curtain attached by fasteners.

2. No good.

3. A hood covers the windows in front and to the side.

4. Only covers left side of cockpit and it is possible to see out the other side.

5. A wood and canvas shield is put over the left side of window. Leaving the right window open. But the instruments keep you from wanting to look out to the right.

6. Canvas over half the front and all of one side - using a lookout in the top turret.

7. Canvas over windshield and left side.

8. Panel blinds inserted into windshield frame.

9. A hood is placed over the windows next to the pilot on instruments. A "lookout" is placed either in the top turret or another vantage place.

SPECIAL FEATURES (continued)

10. A good system (on pilot using instruments) but safety pilot has limited vision out.

Red-Green

1. Restricts visibility too much, especially on hazy days. Not safe!

2. Red windscreen and green goggles. Chase pilot. Bad vision through red.

3. Windshield and snug type goggles. Do not prefer to Blue-Amber.

4. Restricts visibility; don't like.

5. Red goggles. More satisfactory than Blue-Amber.

Cardboard Beak

1. Extend cardboard on head. Front out about 15" with sides. Unable to see all instruments without moving head to see others. N.G. Can cheat easily.

2. A canvas beak attached to clear goggles was used. Chief fault was uncomfortableness of heavy beak.

3. A visor or cap-like affair that shut off vision of all but cockpit and instruments in F4U-4. No need for goggles or artificial lights. Visor fit over head like bookkeeper's eyeshade; size of peak of visor prohibited vision outside unless head was raised in a definite attempt to look out. Clear unlimited vision of all instruments, switches and dials in cockpit.

4. We took a visor - blue and replaced with cardboard 10"-15" long. Concave shaped set at the right place and angle would obscure horizon but not instruments (and not ground). Good visibility instantly if needed.

5. Half cylinder of cardboard attached to clear wide vision glass. Cardboard not too durable. Good otherwise.

6. Beak card - easy to put on and fast to take off in case of emergency. It requires no time to prepare for instrument hops with this system.

7. Light metal hood like a welder's shield that swiveled up or down as desired.

8. Used plastic beak painted black. Let too much light in cockpit. Rays of light and reflection off instruments disconcerting. Blue goggles cut this light down until it is negligible.

SPECIAL FEATURES (continued)

Compartment in NH-1

1. Passenger section was closed off by bulkhead, duplicate instruments and controls installed. Clumsy arrangement, but good system.

2. Had aft cockpit set up and instructor rode in front with normal set up for contact flying. Not too good. Owe to difference of instrument readings.

3. Too closed in and hot. Nauseating. Good instrument vision.

4. Fair except that it requires artificial light.

DIFFICULTIES AND RECOMMENDATIONS
ABOUT AMBER PANELS

1. The combined results of the disturbing effects make vision through amber alone very difficult at times. However, it seems that this system is still more comfortable to the pilot than the beak type.

2. Amber should go all the way around. It should be factory-cut for the various types of planes.

3. Would it help to make the amber a lighter shade and the blue a darker shade and still see the instruments without decreasing the effectiveness of the simulation? This suggestion is offered from the viewpoint of the safety pilot having to keep a continual watch outside the plane for other aircraft.

4. When used in fighter type plane proper fit is impossible on canopy. Opening of canopy usually results in loosening or tearing of amber.

5. Excessive fading of the stock.

6. I have had a student that constantly got sick using amber alone when flying contact.

7. Improve installation to prevent cracking. Careful stowage when not in use.

8. It's possible to see through the Blue-Amber combination under certain conditions; for example, a white beach on a bright day or to distinguish between land and ocean by the sun shining on the surface when flying into the sun.

9. If it is clean, not cracked, have found it o.k.

10. Change of colors does not seem to make any difference. This fault must be purely imagination.

11. Frequent replacement presently necessary.

12. Amber is a good color; it's the blue that cuts visibility.

13. Small cockpits are too confining for the proper care of amber without cracking. The pieces also get in the way, since many squadrons require removal of all amber before landing.

14. Do away with amber - use the cloth hood.

15. Where a safety pilot is used, eliminate amber and use an opaque glass (visor type) which can be removed or moved on a swivel very easily during emergencies. (I have never used a visor type but would like to try.)

AMBER PANELS (continued)

16. Amber cuts down the visibility of the safety pilot so much that it is my opinion it is dangerous.

17. When tape is used to install amber panels the glass becomes gummed with adhesive material. Also, tape is prone to come loose.
It is impossible to cover all glass panels with amber. (It is realized that some light must enter for vision.)

REASONS FOR PREFERENCES AMONG
VARIOUS TYPES OF BLUE GOGGLES

1. I liked the visor type, because it is not necessary to look through the blue glass at the instruments. I would not like to use any goggles directly over the eyes as it would seem that visibility inside the cockpit would be restricted.

2. No special preference; have only used brow-rest extensively, but wouldn't object to trying out others.

3. Prefer some system other than those that include goggles. Goggles tend to introduce an adverse psychological effect upon me.

4. I would like to try some other type (than snug type).

5. Prefer to try less bulky type adaptable to quick conversion (instrument to contact).

6. I found the snug type to be satisfactory.

7. I have only used the snug type goggle during simulated instrument flying and I'm satisfied with this type.

8. Used the above types because they were the only ones provided. Would be glad to use any type considered to be an improvement. (Used brow-rest and snug type.)

9. Would prefer to try other types.

10. Prefer sun glass type with single sheet of blue cut out for nose. Very light weight and no band around head. I find they are the most comfortable.

11. Have experienced some fogging with non-vented snug type goggles. I consider snug type goggles with vents punched in the sides the most satisfactory.

12. Brow-rest more comfortable than the visor type. Snug type fogs too much.

13. Definitely dislike snug type because of the "fogging-up" of them.

14. Try another type that would be easier on the pilot. Ex. (1) Snug type fogs up; (2) Brow-rest - earphone forces ear piece of goggles against head; (3) Visor type - top piece interferes with band on earphones.

15. Brow rest more comfortable and do not fog as easily; also cooler when flying in tropical climate.

16. Very comfortable and light. Would like to try other types (than brow-rest and snug type).

BLUE GOGGLES (continued)

17. Brow-rest is less cumbersome and affords more vision to the sides than snug type. However, the ear supports tend to make the ears sore if worn too long under earphones. Suggest a support which does not encircle the ear but achieves this support by merely gripping the head.

18. I would prefer something that would prevent glare when flying into the sun.

19. Visor permits better vision and does not fog up. Main objection to visor is heavy and cumbersome head bands. Would like to try sun glass type.

20. Snug type is preferred for use in open or canopy cockpit aircraft; brow-rest for cabin type.

21. Prefer brow-rest type due to ease of putting on; they don't fog up, do not interfere with head set, hardly realize they are on. Willing to try anything once; if an improvement over my present choice, would gladly change to that type.

22. Brow-rest type most comfortable and least distracting to use.

23. Yes, the brow-rest is far more comfortable and has less tendency to fog.

24. For radio work, visor type awkward to use with headset (not big enough to go over headset easily, and keeps headset too far off ears when under headset). I would like to try the sun glass type of eye-covering.

25. Brow-rest do not fit next to the skin and do not cramp you as much as snug type.

26. Have used only three types. Snug type was necessary because of open cockpit. Don't feel qualified to comment on different types.

27. Having only used one type I would prefer to try others before making preference.

28. I find the visor type poor for instruments because sun light that is reflected off the glass in the instruments almost blinds the instrument completely.

29. Brow-rest does not give the "closed in" feeling that snug type gives. However, prefer snug type for comfort on nose.

30. Would like to try other types. Blue goggles restrict vision in cockpit - also instrument panel.

31. Prefer snug type; other types allow reflection from charts and publications, etc., when laid in pilot's lap. Suggest mounting small 1/4 inch rubber tubing from snug type to 1/4 fitting through skin of aircraft to produce enough suction to prevent fogging.

BLUE GOGGLES (continued)

32. By using ball cap and visor attached, fogging and cumbersome attachments are done away with allowing comfort using head sets. Would like to try others.

33. Would like to try something new. There is plenty of opportunity for improvement.

34. Prefer snug type so far. Visor no good due to light reflections, cumbersome and uncomfortable. Would like to experiment with other types.

35. I prefer to try out the sun glasses as I think they would be more comfortable and prove just as effective with correct lens in them.

36. Definitely do not like snug type. Uncomfortable, hot, fog up. Would like to try non-fogging type.

37. The snug type with a non-fogging characteristic would be ideal.

38. Visor more comfortable. Goggles effective but sweat fogs them up in hot weather.

39. Prefer brow-rest. Not heavy, does not weight you down.

40. Simulated instrument flying with blue-amber always left me with a headache.

41. The ski type don't fog as easily.

42. Visor with amber window covering allows the safety pilot the most visibility in all directions.

43. Would like to try out other systems.

44. Would like to try something else since these are hard on the eyes (snug type).

45. Would like to have snug type with non-fogging attachment. The visor type is usually too light and student can see through blue-amber outside.

46. The brow-rest is ventilated, light, well constructed and easy to carry in pilot's jacket or flight suit.

47. Brow-rest is easier to wear, does not fog and is more comfortable.

48. Brow-rest is the best I have used. Snug type fogs up too easily. Visor type worries some students.

49. Strongly dislike all types of complimentary color systems. Prefer old canvas hood.

50. I dislike anything put around my face. I have used these goggles and do not like them.

BLUE GOGGLES (continued)

51. Brow-rest is most comfortable and least trouble.

52. Would like to experiment with new goggles.

53. Visor does not fog as badly as goggles.

54. I would prefer trying sun glasses. I believe they would be more comfortable.

55. The brow-rest is the most comfortable in my opinion. The snug type goggles are useless. If it is at all warm, they steam up immediately with use. Visor type is fair except it is too large and inconvenient.

56. Brow-rest gives greatest coverage, is light and comfortable to wear and has the least tendency to fog up.

57. Comfort in wearing of any type glasses or eye-covering methods is priority with me. Some brow-rest fit neatly while visor type draws preference.

58. I prefer the visor because it can be lifted to give a natural view of the instruments which more nearly simulates actual conditions rather than peering through blue glass at all times.

59. I like brow-rest type because of ease of handling, non-fogging and comfortable, sun glare not strong enough to prevent good sight of instruments.

60. Would like to try different types.

61. Would prefer trying new type.

62. Sun glasses are more comfortable. The visor type with a headset is impossible. Also the glass in ones I used was too dark and cockpit lights are not satisfactory.

63. Visor doesn't fog; perspiration doesn't have chance of dropping off brow onto eye covering. Can place visor so as not to peer through it, but will blot out visibility if looking at angle toward windshield.

64. I listed the snug type last because of the fogging up. I prefer the brow-rest type because of the complete coverage of the eyes and they are light in weight and cool to wear in warm climates.

65. I like the visor type because it can be adjusted to allow unrestricted vision when needed; also it can be adjusted to allow a blackout above the instrument panel while giving the wearer a clear view of the instruments.

66. I would like to try the Beak-Type using snug type goggles. And a visor type to flip up with a durable frame and edging for strength on visor - compact enough for F8F.

BLUE GOGGLES (continued)

67. Blue-Amber type involved too much gear to use in a small fighter such as the F8F. Cardboard visor alone on clear glass (or frames alone) was sufficient in restricting vision to instruments and was light enough not to be uncomfortable for normal length hops. Blue goggles often became hot and fogged up.

68. Would like to try visor. In hot weather excessive perspiration in eyes with goggles.

69. Would like to use other types. Have had occasion only to use the types specified above. (Snug type and visor.)

70. Snug type tended to fog up rapidly. No way of contending fog. Brow-rest type fogged on occasion during warm weather. Also bright sunlight cast shadows in turns making it difficult to see instruments.

71. Having always used the snug type, I can make no comment on any other type. However, I believe that the best visibility is afforded by this type.

72. Brow-rest.goggles exert less pressure, are lighter in weight, do not fog and interfere less with ear-phones than previous types used.

73. Only goggle that I've ever had occasion to use. (Snug)

74. Brow-rest goggles are more easily fitted, and are more comfortable to wear.

75. The brow-rest are more comfortable and fog up less. My preference would be for no goggles at all where your complete view on simulated instruments practice would be the same as actual weather conditions. This would help to reduce somewhat the psychological effect on each pilot when going from practice to actual instrument flying.

76. Snug type goggle is the best goggle for use in single-engine aircraft. It is easy to carry around the neck during take-off, is fairly easy to put on in the limited space available in single engine aircraft and it is easy to remove in case of emergency.

77. I prefer the brow-rest because of lightness of construction similar to sun glasses.

78. Snug type fogs up in warm weather. Brow-rest seems to be the best for transports.

79. Prefer brow-rest because of its light weight and ease of removing in emergencies. I would like to try a visor type without the encumbrances of glasses; i.e., a frosted plastic visor or one painted black that is easily removed for emergencies. This affords safety pilot excellent visibility in all directions.

80. Reason for preference is because this type was mostly used. Did not have opportunity to use other type of glasses. (Brow-rest over snug type.)

BLUE GOGGLES (continued)

81. The visor is easier to use.

82. Would like to try the non-fogging type in cold weather and the visor type for comfort.

83. Prefer brow-rest due to vision field. In fighter type aircraft where using helmets, it is impractical and snug type is much more successful due to ease of use.

84. I would prefer to try out some type of which I have not used. However I believe I would prefer venetian blinds to <u>any type</u> goggles.

85. Brow-rest type are not heavy, do not fog easily.

86. Always room for improvement -- like snug type for CV work.

87. Consider brow-rest most practical.

88. Blue visor with amber panels in windows more comfortable. Have used goggles in single-engine mostly.

89. More comfortable, easier to get off in emergency, easier to get on. (Snug type.)

90. The snug type goggles work out very well, are comfortable and easy to attach and keep in place. Would like to use some of the other types of goggles as I have used only the two types. (Brow-rest and snug type.)

91. I like the visor because by raising the head you can come contact more quickly than trying to remove the snug type from over the eyes. Your vision is not restricted by the use of the amber hood then.

92. I have found the snug type to be entirely adequate and their lightness makes then quite comfortable. Sun glasses tend to hurt one's ears because the helmet holds them to firmly against the head of the pilot.

93. Would like to try non-fogging (X-Vent) type. No particular reason except habit for preference.

94. I like snug type with amber panels best, because this is easier and more comfortable to use.

95. Sun reflects behind the brow-rest and visor type.

96. I prefer the brow-rest for comfort, ventilation and minimum of fogging.

97. The brow-rest is less of a bother; i.e., wearer is less conscious of wearing than other types of goggles although it is my opinion that there could be improvements made on all goggle hood arrangements this pilot has used. Actual instrument conditions afford the best experience.

98. The brow-rest type looks more comfortable and would provide a wider field of vision.

GENERAL RECOMMENDATIONS
AND OTHER COMMENTS

1. Get rid of beak if possible.

2. If feasible, try to use clear polaroid for blocking out sight through windshield.

3. Blue-Amber best system I have used. Gives you more of a feeling of actual instruments than hood.

4. If some light color amber or other could be devised that would not restrict vision the actual windshield of the plane could be made of this color glass. Of course it would have to be of a color not to affect use of plane at night. Probably installed in planes used just for instrument training.

5. Polarized glass.

6. Use deep color in hoods and goggles so windows will be black, use vents in goggles. Blue-Amber system is satisfactory.

7. In general, both the Blue-Amber and Red-Green systems have the same general faults. The amber windshield seems to give a little better vision without the goggles than the green, and doesn't seem to mar or scratch as quickly. The reflection from the sun in the amber is much worse than the green, and tends to be very detrimental for training purposes. In hazy weather, visibility through the amber is very poor and as a result is dangerous. It is much easier to "cheat" with the Blue-Amber than with the Red-Green system.

8. Make a unit that is compact that would have both colors in it and so it would fit a given cockpit. Also keep it stored in a box to keep dust off and prevent breaking. Blue-Amber system is good, serves purpose and is safer than any other system but too much time is lost in covering windshield.

9. Blue-Amber system very good except when amber becomes cracked and dirty. Something to clean amber with and something to help preserve amber.

10. Make goggles of Blue-Amber system more comfotable and with better overhead vision.

11. Faster and better windshield installation by standardization of type equipment. Use clips and have installed when delivered.

12. I think present system (Blue-Amber) could be improved upon but I think it's a 100% better over the old canvas hood ~~system~~ which was not only dangerous but was a mental hazard.

13. It is believed that a better system of installing the amber glass could

be devised; such as utilizing clips or snaps that would cut down the time required for installation.

14. Make the visor type more comfortable and practical to wear with headset.

15. There should be some way to install the amber besides using masking or any adhesive tape. Clamps installed on the edge of the window ledge may help.

16. In the SNJ smoother system might be used besides the hood. Anyone of the systems using the goggles would be better suited. These would allow freedom of motion and also be more nearly like actual instruments. Therefore when under actual instruments for the first time the pilot would not feel so strange when he sees that white mass and his wings sticking out with no hood to keep his mind on the instruments.

17. Improve comfort of goggles. It would be nice to have double panes of polaroid glass where amber is now. Then by turning one pane, could cut off all visibility, would need no goggles, would have clear panels for landing without color.

18. Reverse amber and blue. Amber goggles, blue windows.

19. Have some small glasses that will cover the eyes sufficiently, easy to carry, comfortable.

20. Do not like the mechanical hood types. Consider safety factor is poor.

21. Think Blue-Amber good.

22. The system of Venetian Blinds in the R4D in my opinion is the finest system.

23. I would like to see a light colored material (amber or white) used in the goggles and panels using the polarization principle to block the students' vision past the cockpit. Goggles, especially, should be very comfortable to wear.

24. Make the Venetian Blind of lighter material. This is by far the best type of hood. Second choice is the amber glass with blue visor. Any type of goggles are impractical due to fitting tight and fogging. The visor type is light weight and doesn't fit too tight.

25. I can think of no way to improve Blue-Amber method, but I believe that if there is a way to bring in the properties of polaroid ground lenses and eliminate Blue-Amber entirely it would be a far better system.

26. Would like to see polarized glass used so that hood could be used to fly simulated instruments at night. Amber glass restricts pilot's vision outside and blue goggles make cockpit too dark for student to see instruments at night or on dark days. Cockpit lighting doesn't make instruments bright enough to read through blue goggles.

GENERAL COMMENTS (Continued)

27. Make the amber and blue more durable and easier to install. Make it easier to see through (less scratching and dirt collecting).

28. Clean, flat on the panel installation.

29. In my estimation the Benetian Blind is the safest rig. It keeps the student on the gauges and still lets the instructor have vision to port. There is also no distortion through colored glass. There is no discomfort to the student by having "junk" or "rigs" straped to his head. It is by far the best method I have yet encountered.

30. Have the particular plane manufacturer have patent installations for the particular type plane. Once the installation system is standardized, no troubles.

31. Venetian Blind system – In my opinion it is potentially the best for multi-engine training. Cover only the pilot side and design angle of blinds so safety pilot will not have to lean forward in seat to see. No conscientious pilot who realizes value of training will try to "cheat"; besides, multi-engine flying is 75% instrument work even under "contact" conditions.

32. Have original configuration of aircraft include instrument simulation facilities.

33. Shorten the beak shield. It is possible to practice instruments without use of anything except a long billed cap, lowering the seat and not cheating.

34. For the SNJ a hood is acceptable because it is adequate and comfortable.

35. I instructed in F/I's (instrument flying) for a year and newer had anything but praise for the Venetian Blind system.

36. Install slots at top and bottom of windows so that amber glass panels could be quickly slid into place. Use in conjunction with blue glass equipment which does not squeeze head, bridge of nose or ears. Especially when wearing headset. Glasses could quite possibly be installed on visor.

37. Need system devised to afford safety pilots all possible visibility. Canvas hood affords greatest comfort for simulating instruments.

38. Make Blue-Amber system more durable and easier to install.

39. Improve amber material by pre-molding. Fewer fasteners would be needed and amber would last longer. Would still like plain beak in small fighter type.

40. Be sure hood in SNJ covers horizon. Always use individual amber panels rather than frame.

GENERAL COMMENTS (continued)

41. Develop some method which simulates actual instrument conditions, i.e., soft colors as are encountered in clouds or fog. Blue-Amber is too dark for the person wearing the goggles and too bright for instructor or check-pilot.

42. I do not care for the Blue-Amber system at present. However, it could be made the safest system.

43. Perfect polaroid glass to be used with polaroid glasses.

44. I think that amber colored windshields would be much more ideal if they could retain polaroid characteristics. On several flights I have hoods placed up to relieve the glare of the sun and snow - with windshields always ready. It would then be merely a case of putting on comfortable goggles. To relieve pressure about the ear with goggles and headsets on - why not have goggles held on with clasp as in new type eyeglasses?

45. To improve vision through amber alone without changing vision through Blue-Amber. Puts more strain on check pilot than hooded pilot.

46. I think a combination of the beak type and Blue-Amber would bring proficiency up a great deal in single seat aircraft.

47. I believe if the Beak system could be refined so that the beak and goggles could be combined in one piece of equipment which could easily be donned and removed while wearing a helmet it would prove to be the most satisfactory of the systems so far devised.

48. Blue-Amber: Easier methods of installation.

49. The Venetian Blind system in my opinion is ideal; the others - no good.

50. Maximum effect of instrument flying is obtained with Blue-Amber but its safety value is 0%. Pilot efficiency can be maintained just as well with Venetian Blinds and safety value is 100%. I have personally had too many near collisions with other aircraft while using Blue-Amber.

51. Make Blue-Amber system designed for type of aircraft. Improve SNJ hood to eliminate excessive wear.

52. Blue-Amber safety might be increased by providing amber pieces that can be removed by the pilot in landing and takeoff.

53. Something for VF pilots so they can use their own goggles, but be able to come out from under blue glass in a hurry.

54. For single-engine planes, I believe the beak type is tops. Easy to carry, to put on and remove.

55. Make amber glass so you cannot see through with Blue-Amber on.

GENERAL COMMENTS (continued)

56. The goggles or hoods, etc. used should be designed to give good cockpit vision, should be cool, and most of all should be easily and rapidly assembled or removed in cases of emergency.

57. Hoods are good in two seater single-engine. Recommend half hoods for multi-engine. Recommend that a combination brow and sun glasses be made with ground blue glass - expense would enter picture.

58. I have never used Venetian Blinds for blind flying but from what has been learned from other conversations and experiences I imagine it as being a very good system both as far as safety and comfort are concerned on both pilot and safety pilot. All other systems can stand a lot of improvement toward making the pilot using them feel normal in respect to vision.

59. I think simulated instrument flying is one of the most dangerous types of flying, due to:
1. Systems used.
2. Only one pair of eyes looking out - (a lookout between pilots helps
3. An area for simulated instruments flying is not established and controlled.

I do not think simulated instrument flying should be conducted unless the weather is CAVU.

END

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ABSTRACT:

In order to determine the important areas of agreement and disagreement concerning simulated blind flying equipment, a questionnaire was administered to 143 Navy pilots at two air stations. Information about usage of the equipment, evaluations of various systems, and difficulties with and desired improvements in the blue-amber system were obtained on the basis of actual flying experience. The most used systems were found to be regular blue amber, SNJ hood, and multi-engine hood. Respondents indicated that the blue-amber system causes difficulty, and proper and careful usage practices are recommended for effective functioning of the system.

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